



# Public Works and Government Services Canada

Requisition No: EZ899-150798

DRAWINGS & SPECIFICATIONS  
for

Transport Canada Sandspit Airport  
Combined Services Building HVAC Rehabilitation

Project No:

R.077014.001

APPROVED BY:

  
Regional Manager, AES

2016-09-09  
Date

  
Construction Safety Coordinator

2016-08-08  
Date

TENDER:

  
Jimmy Wong  
Project Manager

July 27, 2016  
Date





**CONSULTANTS – SEAL & SIGNATURE**

Discipline

Seal / Signature / Date


Mechanical  
(Prime)



*[Handwritten Signature]*  
July 27/16

A red circular seal for a Professional Engineer in the Province of British Columbia. The seal contains the text: "PROFESSIONAL ENGINEER", "PROVINCE OF BRITISH COLUMBIA", and "M. MARKOVIC 24824". A handwritten signature in black ink is written over the seal, and the date "July 27/16" is written below it.

Electrical



*[Handwritten Signature]*  
July 27, 2016

A red circular seal for a Professional Engineer in the Province of British Columbia. The seal contains the text: "PROFESSIONAL ENGINEER", "PROVINCE OF BRITISH COLUMBIA", and "L. P. GANDER". A handwritten signature in blue ink is written over the seal, and the date "July 27, 2016" is written below it.

**END OF SECTION**



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**ELECTRICAL**

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## **1 GENERAL**

### **1.1 Related Requirements**

- .1 Section 01 11 55 General Instructions
- .2 Section 01 35 13 Special Procedures for Airport Facilities
- .3 Section 01 56 00 Temporary barriers and Enclosures

### **1.2 Work Covered by Contract Documents**

- .1 Work of this contract comprises upgrading ventilation systems in one building and associated general, electrical, commissioning, plumbing, etc. at Sandspit Airport (Combined Services Building). Work is comprised of tasks listed in Section 01 11 55, Item 1.3 Description of Work.

### **1.3 Contract Method**

- .1 Construct Work under lump sum stipulated price contract.
- .2 Relations and responsibilities between Contractor and subcontractors are as defined in Conditions of Contract. Assigned Subcontractors must, in addition:
  - .1 Furnish to Contractor, bonds covering faithful performance of subcontracted work and payment of obligations thereunder.
  - .2 Purchase and maintain liability insurance to protect Contractor from claims for not less than limits of liability which Contractor is required to provide to the Departmental Representative.

### **1.4 Work by Others**

- .1 Co-operate with other Contractors on site in carrying out their respective works and carry out instructions from the Departmental Representative.
- .2 Co-ordinate work with that of other Contractors. If any part of work under this Contract depends for its proper execution or result upon work of another Contractor, report promptly to the Departmental Representative, in writing, any defects which may interfere with proper execution of Work.

### **1.5 Work Sequence**

- .1 Construct Work in stages to accommodate Owner's continued use of premises during construction.
- .2 Co-ordinate Progress Schedule and co-ordinate with Owner Occupancy during construction.
- .3 Construct Work in stages to provide for continuous usage.
- .4 Maintain fire access/control.

### **1.6 Contractor Use of Premises**

- .1 Co-ordinate use of premises under direction of the Departmental Representative.

- .2 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
- .3 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.
- .4 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by the Departmental Representative.
- .5 At completion of operations condition of existing work: equal to or better than that which existed before new work started.
- .6 Use of Site:
  - .1 Exclusive and complete for execution of work.
  - .2 Assume responsibility for assigned premises for performance of this work.
  - .3 Be responsible for coordination of all work activities on site, including the work of other contractors engaged by the Departmental Representative.
  - .4 Provide security of Contractor's work site and all Contractors and Sub-Contractors.
  - .5 Perform work in accordance with the Contract documents. Ensure work is carried out in accordance with indicated phasing.
  - .6 Do not unreasonably encumber the site with material or equipment.
  - .7 Do not obstruct access to Transport Canada property outside of the Contractor's work site. Maintain overhead clearances, keep roadways and walkways clear, and maintain routes for emergency response vehicles.
- .7 Perform work in accordance with Contract documents. Ensure work is carried out in accordance with approved schedules.
- .8 Refer to Section 01 35 13 – Special Procedures for Airport Facilities.

### **1.7 Owner Occupancy**

- .1 Owner will occupy premises prior to, and after, completion of each separate phase of work.
- .2 Co-operate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage.

### **1.8 Partial Owner Occupancy**

- .1 Schedule and substantially complete designated portions of Work for Owner's occupancy prior to Substantial Performance of entire Work.
- .2 Execute Certificate of Substantial Performance for each designated portion of Work prior to Owner occupancy. Contractor shall allow:
  - .1 Access for Owner's personnel.
  - .2 Use of parking facilities.
  - .3 Operation of HVAC and Electrical Systems.



- .3 On occupancy, Owner will provide for occupied areas:
  - .1 Operation of HVAC and Electrical Systems.
  - .2 Maintenance.
  - .3 Security.

### **1.9 Contractor's Responsibilities**

- .1 Designate submittals and delivery date for each product in progress schedule.
- .2 Review shop drawings, product data, samples, and other submittals. Submit, to the Departmental Representative, notification of observed discrepancies or problems anticipated due to non-conformance with Contract Documents.
- .3 Receive and unload products at site.
- .4 Inspect deliveries jointly with Owner; record shortages, and damaged or defective items.
- .5 Handle products at site, including uncrating and storage.
- .6 Protect products from damage, and from exposure to elements.
- .7 Assemble, install, connect, adjust, and finish products.
- .8 Provide installation inspections required by public authorities.
- .9 Repair or replace items damaged by Contractor or subcontractor on site (under his control).

### **1.10 Alterations, Additions or Repairs to Existing Building**

- .1 Execute work with least possible interference or disturbance to building operations, occupants and normal use of premises. Arrange with the Departmental Representative to facilitate execution of work.

### **1.11 Existing Services**

- .1 Notify Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give the Departmental Representative 48 hours' notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to tenant operations.
- .3 Provide alternative routes for personnel, pedestrian and vehicular traffic as required.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify the Departmental Representative of findings.
- .5 Submit schedule to and obtain approval from the Departmental Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .6 Provide temporary services when directed by the Departmental Representative to maintain critical building and tenant systems.
- .7 Where unknown services are encountered immediately advise the Departmental Representative and confirm findings in writing.

- .8 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .9 Record locations of maintained, re-routed and abandoned service lines.
- .10 Construct barriers in accordance with Section 01 56 00 – Temporary Barriers and Enclosures.

**END OF SECTION**

## 1 GENERAL

### 1.1 Related Sections

.1	Section 01 11 00	Summary of Work
.2	Section 01 14 00	Work Restrictions
.3	Section 01 29 00	Payment Procedures
.4	Section 01 31 19	Project Meetings
.5	Section 01 32 19	Security
.6	Section 01 33 00	Shop drawings, Product Data and Sample
.7	Section 01 35 13	Special Procedures for Airport Facilities
.8	Section 01 35 33	Health and safety Requirements
.9	Section 01 35 43	Environmental Procedures
.10	Section 01 41 00	Regulatory Requirements
.11	Section 01 45 00	Quality Control
.12	Section 01 51 00	Temporary Facilities
.13	Section 01 52 00	Construction Facilities
.14	Section 01 56 00	Temporary Barriers and Enclosures
.15	Section 01 61 00	Common Product Requirements
.16	Section 01 61 10	Product Requirements
.17	Section 01 71 00	Examination and Preparation
.18	Section 01 73 00	Execution
.19	Section 01 74 11	Cleaning
.20	Section 01 74 19	Waste Management and Disposal
.21	Section 01 77 00	Closeout Procedures
.22	Section 01 78 30	Closeout Submittals
.23	Section 01 79 00	Demonstration and Training
.24	Section 01 91 00	Commissioning
.25	Section 01 91 31	Commissioning (Cx) Plan

### 1.2 Codes

- .1 Perform Work in accordance with the National Building Code of Canada 2010, Worker's Compensation Board of BC and any other code of provincial or local application provided. In any case of conflict or discrepancy, the more stringent requirements shall apply.

### 1.3 Description of Work

- .1 Work under this Contract covers HVAC rehabilitation for the Sandspit Airport Combined Services building, located in Sandspit, B.C.
- .2 Work under this Contract comprises but is not limited to, the provision of all labour, materials, services and equipment necessary for the upgrade of the ventilation system in one building as fully described in the Tender Documents.
  - .1 Combined Services Building
    - .1 Refurbishment of the existing unit will include replacement of the following:
      - .1 Supply fan motor
      - .2 Belts

- .3 Sheaves
  - .4 Heating coil
  - .5 Return fan
  - .6 Outdoor air and return air dampers
  - .7 25 mm thermal insulation on the o/a intake plenum
  - .8 3-way control valve associated with the heating coil loop
  - .9 Circulation pump for heating coil
- .2 The existing air handling unit and the existing air compressor in boiler room are to be seismically restrained.
- .3 Upgrading of the existing DDC system will include installation, programming and commissioning of a complete microprocessor based automatic control system. This system will be manufactured by Alerton Controls, installed by Cougar Pacific Controls and fully integrated with the existing Main Airport Terminal Building DDC System. The Control System shall be installed by the Control Contractor but as an integral part of the Mechanical Sub-contract. All instrument calibrations and readouts shall include SI metric units. Temperatures shall be reported in degrees Celsius. The system shall consist of all microprocessor based controllers, sensors, wells, automatic control valves, control dampers, transducers and relays.
- .4 Existing low voltage control valves on all existing hot water wall fin baseboard heaters shall be replaced. New zone control valves shall be On-off, two-way, low voltage valves with an actuator and valve assembly for controlling the flow of hot water. In addition, all existing thermostats shall be replaced
- .5 Replace all boiler vents with stainless double wall AL29-4C vents as recommended by boiler manufacturer. This shall include replacement of venting above roof. Terminate vent as per manufacturer's recommendation.
- .6 Boiler 2 shall be connected to emergency power source and a boiler kill switch shall be provided.
- .7 Two new boilers shall be provided by Transport Canada. Contractor is to install new boilers per manufacturer's recommendations.
- .8 The DDC control sequence for boilers shall be revised to ensure that a minimum return water temperature is maintained when boilers are in operation. The current strategy, which employs an outdoor reset, shall be eliminated.
- .9 The existing boilers' piping shall be reconfigured per manufacturer's specifications. The control sequence for boilers staging shall be revised to take into account different return water temperatures for each boiler's operation.

- .10 Existing ventilation in the Welding Shop shall be upgraded. Provide a new roof mounted, spark resistant, and explosion proof exhaust fan. Provide a new wall mounted flexible arm fume extractor. Existing ductwork can be reused. Balance general exhaust and point of source air volumes to meet required fume capture velocities at ceiling register and arm hood.
- .11 Provide new spark resistant and explosion proof exhaust air system for Battery Storage Room. Inline exhaust fan will be mounted at the mezzanine with gooseneck discharge at the roof level.
- .12 Provide new spark resistant and explosion proof exhaust air system for Carpentry Storage Room. Inline exhaust fan will be mounted at the mezzanine with gooseneck discharge at the roof level.
- .13 Replace existing inline exhaust fan that provides service to main floor washrooms. Existing ductwork can be reused.
- .14 Include all associated cutting, patching and painting as required to complete the ventilation upgrade Work.
- .15 Include all electrical Work as shown on the electrical drawings and noted in the specifications.
- .16 Include all commissioning Work as noted in the Mechanical Specification.
- .17 Fans that are being refurbished or replaced will have wiring to them disconnected and upon completion of Work will be reconnected using flexible connections to them. Fan starters will be replaced to reset the life of the starters. The existing starters are in operation but are close to thirty years old. Starter replacement is appropriate since the fans are being refurbished or replaced and the likelihood of the new starters requiring service or repair is reduced, which is of particular importance given the remoteness of the facility. Existing wiring is in good condition and will be re-used. Refer to drawing E-1 for specific details regarding fan refurbishment or replacement.

#### **1.4 Contract Documents**

- .1 The Contract documents, drawings and specifications are intended to complement each other, and to provide for and include everything necessary for the completion of the Work.
- .2 Drawings are, in general, diagrammatic and are intended to indicate the scope and general arrangement of the Work.

#### **1.5 Division of Specifications**

- .1 The specifications are subdivided in accordance with the current 6-digit National Master Specifications System.

- .2 A division may consist of the Work of more than 1 subcontractor. Responsibility for determining which subcontractor provides the labour, material, equipment and services required to complete the Work rests solely with the Contractor.
- .3 In the event of discrepancies or conflicts when interpreting the drawings and specifications, the specifications govern.

## **1.6 Time of Completion**

- .1 Complete the Ventilation System Upgrade project at the Sandspit Airport Combined Services Building ready for use within sixteen (16) weeks after the Work start date of **Contract Award Date**.
- .2 Commence Work after official notification of acceptance of offer and not before **Contract Award Date**.

## **1.7 Hours of Work**

- .1 Restrictive as follows:
  - .1 Normal weekday working hours of the building are 7:30 to 16:00 hours.
  - .2 The contractor will have 24 hour access to the buildings in unrestricted areas.
  - .3 Notify Departmental Representative when afterhours Work, including weekends and holidays, is required.

## **1.8 Work Schedule**

- .1 Carry on Work as follows:
  - .1 Within 10 working days after Contract award, provide a “phasing bar chart” [GANNTT] and a schedule showing anticipated progress stages and final completion of the Work within the time period required by the Contract documents. Indicate the following:
    - .1 Submission of shop drawings, product data, MSDS sheets and samples.
    - .2 Commencement and completion of Work of each section of the specifications or trade for each phase as outlined.
    - .3 Final completion date within the time period required by the Contract documents.
  - .2 Do not change approved Schedule – without notifying Departmental Representative.
  - .3 Interim reviews of Work progress based on Work schedule will be conducted as decided by Departmental Representative and schedule updated by Contractor in conjunction with and to approval of Departmental Representative.

## **1.9 Cost Breakdown**

- .1 Before submitting the first progress claim, submit a breakdown of the Contract lump sum prices in detail as directed by the Departmental Representative and aggregating Contract price. After approval, the cost breakdown will form the basis of progress payments.
- .2 Within 2 weeks after award of contract, provide monthly cash flow projection for the whole contract period in detail as directed by Department Representative. Contractor should provide a monthly update of the cash flow projection according to the actual Work schedule.

### **1.10 Codes, Bylaws, Standards**

- .1 Perform Work in accordance with the National Building Code of Canada (NBC) 2010 and other indicated Codes, Construction Standards and/or any other Code or Bylaw of local application.
- .2 Comply with applicable local bylaws, rules and regulations enforced at the location concerned.
- .3 Meet or exceed requirements of Contract documents, specified standards, codes and referenced documents.
- .4 In any case of conflict or discrepancy, the most stringent requirements shall apply.

### **1.11 Documents Required**

- .1 Maintain 1 copy each of the following at the job site:
  - .1 Contract drawings.
  - .2 Contract specifications.
  - .3 Addenda to Contract documents.
  - .4 Copy of approved Work schedule.
  - .5 Reviewed/approved shop drawings.
  - .6 Change orders.
  - .7 Other modifications to Contract.
  - .8 Field test reports.
  - .9 Reviewed/approved samples.
  - .10 Manufacturers' installation and application instructions.
  - .11 One set of record drawings and specifications for "as-built" purposes.
  - .12 National Building Code of Canada 2010.
  - .13 Current construction standards of Workmanship listed in technical Sections.
  - .14 Building Safety Plan.
  - .15 Health and Safety Plan and other safety related documents.

### **1.12 Regulatory Requirements**

- .1 Obtain and pay for – Building Permit, Certificates, Licenses and other permit required by regulatory municipal, provincial or federal authorities to complete the Work.
- .2 Provide inspection authorities with plans and information required for issue of acceptance certificates.
- .3 Furnish inspection certificates in evidence that the Work installed conforms to the requirements of the authority having jurisdiction.

### **1.13 Contractor's Use of Site**

- .1 Use of site:
  - .1 Exclusive and complete in phased areas for execution of Work.
  - .2 Assume responsibility for assigned premises for performance of this Work.

- .3 Be responsible for coordination of all Work activities on site, including the Work of other contractors engaged by the Departmental Representative such as moving contractors and furniture installers.
- .4 Perform Work in accordance with Contract documents. Ensure Work is carried out in accordance with indicated phasing.
- .5 Do not unreasonably encumber site with material or equipment. Coordinate with Department Representative for material storage on site which belongs to the project but waiting to be installed.
- .6 Protect walls.
- .7 Accept liability for damage, safety of equipment and overloading of existing equipment.

#### **1.14 Examination**

- .1 Examine site and be familiar and conversant with existing conditions likely to affect Work
- .2 Provide photographs of surrounding properties, objects and structures liable to be damaged or be the subject of subsequent claims.

#### **1.15 Existing Services**

- .1 Where Work involves breaking into or connecting to existing services, carry out Work at times directed by the authorities having jurisdiction.

#### **1.16 Location of Equipment and Fixtures**

- .1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.
- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space, and in accordance with manufacturer's recommendations for safety, access and maintenance.
- .3 Inform Departmental Representative of impending installation and obtain approval for actual locations.
- .4 Submit field drawings or shop drawings to indicate the relative position of various services and equipment when required by the Departmental Representative.

#### **1.17 Cutting and Patching**

- .1 Cut existing surfaces as required to accommodate new Work.
- .2 Remove items so shown or specified.
- .3 Do not cut, bore, or sleeve load-bearing members.
- .4 Make cuts with clean, true, smooth edges. Make patches inconspicuous in final assembly.
- .5 Fit Work airtight to pipes, sleeves ducts and conduits.
- .6 Conceal pipes, ducts and wiring in raised floors, wall and ceiling construction of finished areas except where indicated otherwise.



- .7 Patch and make good surfaces cut, damaged or disturbed, to Departmental Representative's approval. Match existing material, colour, finish and texture.
- .8 Install firestops and smoke seals in accordance with ULC-S115, around pipe, ductwork, cables and other objects penetrating fire separations to provide fire resistance not less than the fire resistance of surrounding floor, ceiling and wall assembly.
- .9 Making good is defined as matching construction and finishing materials and the adjacent surfaces such that there is no visible difference between existing and new surfaces when viewed from 1.5 metres in ambient light, and includes painting the whole surface to the next change in plane.

#### **1.18 Setting Out of Work**

- .1 Assume full responsibility for and execute complete layout of Work to locations, lines and elevations indicated.
- .2 Provide devices needed to lay out and construct Work.
- .3 Supply such devices as templates required to facilitate Departmental Representative's inspection of Work.

#### **1.19 Acceptance of Substrates**

- .1 Each trade shall examine surfaces prepared by others and job conditions which may affect his/her Work, and shall report defects to the Departmental Representative. Commencement of Work shall imply acceptance of prepared Work or substrate surfaces.

#### **1.20 Quality of Work**

- .1 Ensure that quality Workmanship is performed through use of skilled tradesmen, under supervision of qualified journeyman.
- .2 The Workmanship, erection methods and procedures to meet minimum standards set out in the National Building Code of Canada 2010 and Construction Standards as specified herein.
- .3 In cases of dispute, decisions as to standard or quality of Work rest solely with the Departmental Representative, whose decision is final.

#### **1.21 Works Coordination**

- .1 Coordinate Work of Sub-trades
  - .1 Designate one person to be responsible for review of contract documents and shop drawings and managing coordination of Work.
- .2 Convene meetings between subcontractors whose Work interfaces and ensure awareness of areas and extent of interface required.
  - .1 Provide each subcontractor with complete plans and specifications for Contract, to assist them in planning and carrying out their respective Work.
  - .2 Develop coordination drawings when required, illustrating potential interference between work of various trades and distribute to affected parties.
    - .1 Pay particular close attention to overhead Work above ceilings and within or near to building structural elements.

- .2 Identify on coordination drawings, building elements, service lines, rough-in points and indicate location services entrance to site.
  - .3 Facilitate meeting and review coordination drawings. Ensure subcontractors agree and sign off on drawings.
  - .4 Publish minutes of each meeting.
  - .5 Plan and coordinate Work in such a way to minimize quantity of service line offsets.
  - .6 Submit copy of coordination drawings and meeting minutes to Departmental Representative for information purposes.
- .3 Submit shop drawings and order of prefabricated equipment or rebuilt components only after coordination meeting for such items has taken place.
  - .4 Work coordination:
    - .1 Ensure cooperation between trades in order to facilitate general progress of Work and avoid situations of spatial interference.
    - .2 Ensure that each trade provides all other trades reasonable opportunity for completion of Work and in such a way as to prevent unnecessary delays, cutting, patching and removal or replacement of completed Work.
    - .3 Ensure disputes between subcontractors are resolved.
  - .5 Departmental Representative is not responsible for, or accountable for extra costs incurred as a result of Contractor's failure to coordinate Work.

#### **1.22 Approval of Shop Drawings, Product Data and Samples**

- .1 In accordance with Section 01 33 00, submit the requested shop drawings, product data, MSDS sheets and samples indicated in each of the technical Sections.
- .2 Allow sufficient time for the following:
  - .1 Review of product data.
  - .2 Approval of shop drawings.
  - .3 Review of re-submission.
  - .4 Ordering of approved material and/or products – refer to individual technical sections of the specifications.

#### **1.23 Project Meeting**

- .1 Departmental Representative will arrange project meetings and assume responsibility for setting times and recording and distributing minutes.

#### **1.24 Testing and Inspection**

- .1 Particular requirements for inspection and testing to be carried out by testing service or laboratory approved by the Departmental Representative are specified in Section 01 45 00 – Quality Control.
- .2 The Contractor will appoint and pay for the services of testing agency or testing laboratory as specified, and where required for the following:
  - .1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.
  - .2 Inspection and testing performed exclusively for Contractor's convenience.

- .3 Testing, adjustment and balancing of conveying systems, mechanical and electrical equipment and systems:
  - .1 Mill tests and certificates of compliance.
  - .2 Tests specified to be carried out by Contractor under the Departmental Representative's supervision.
- .3 Where tests or inspections by designated testing laboratory reveal Work is not in accordance with the Contract requirements, Contractor shall pay costs for additional tests or inspections as the Departmental Representative may require to verify acceptability of correct Work.
- .4 Contractor shall furnish labour and facilities to:
  - .1 Notify Departmental Representative in advance of planned testing.
- .5 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.
- .6 Pay costs for uncovering and making good Work that is covered before required inspection or testing is completed and approved by Departmental Representative.
- .7 The Departmental Representative may require, and pay for, additional inspection and testing services.
- .8 Provide Departmental Representative with 2 copies of testing laboratory reports as soon as they are available.

#### **1.25 As-Built Documents**

- .1 The Departmental Representative will provide 2 sets of drawings, 2 sets of specifications, and 2 copies of the original AutoCAD files for "as-built" purposes.
- .2 Keep one set of current white prints of all contract documents and addenda, revisions, clarifications, change orders, and reviewed shop drawings in the site office and have them available at all times for inspection by the Departmental Representative.
- .3 As Work progresses, maintain accurate records to show all deviations from the Contract documents. Note on as-built specifications, drawings and shop drawings as changes occur.
- .4 Provide accurate as-built drawings by a qualified professional surveyor identifying the various elements shown on the drawings of the required format.
- .5 At completion of the Work, transfer all deviations, including those called up by addenda, revisions, clarifications, shop drawings and change order, to a set of Issued for Construction drawings. Submit the "red marked" as-built set to the Departmental Representative in hard copy with contractor's review stamp and date confirming that the set submitted is a true record of "as-built" information.
- .6 Refer to Section 01 78 33 – Close-out Submittals.

#### **1.26 Cleaning**

- .1 Daily conduct cleaning and disposal operations. Comply with local ordinances and anti-pollution laws.
- .2 Ensure cleanup of the Work areas each day after completion of Work.

- .3 Clean interior building areas when ready to receive finish painting and continue cleaning on an as-needed basis until building is sufficiently completed or ready for occupancy.
- .4 In preparation for interim and final inspections:
  - .1 Examine all sight-exposed interior and exterior surfaced and concealed spaces.
  - .2 Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior finished surfaces, including glass and other polished surfaces.
- .5 Use cleaning materials and methods in accordance with instructions of the manufacturer of the surface to be cleaned.
- .6 Refer to Section 01 74 11 – Cleaning.

#### **1.27 Dust Control**

- .1 Provide temporary dust tight screens or partitions to localize dust generating activities, and for protection of Workers, finished areas of Work and public.
- .2 Protect furnishings within Work area with 0.102 mm thick polyethylene film during construction. Remove film during non-construction hours and leave premises in clean, unencumbered and safe manner for normal daytime function.
- .3 Maintain and relocate protection until such Work is complete.

#### **1.28 Environmental Protection**

- .1 Prevent extraneous materials from contaminating air beyond construction area, by providing temporary enclosures during Work.
- .2 Do not dispose of waste or volatile materials into water courses, storm or sanitary sewers.
- .3 Ensure proper disposal procedures in accordance with all applicable territorial regulations.

#### **1.29 Additional Drawings**

- .1 The Departmental Representative may furnish additional drawings for clarification. These additional drawings have the same meaning and intent as if they were included with plans referred to in the Contract documents.
- .2 Upon request, Departmental Representative may furnish up to a maximum of 10 sets of Contract documents for use by the Contractor at no additional cost. Should more than 10 sets of documents be required the Departmental Representative will provide them at additional cost.

#### **1.30 Building Smoking Environment**

- .1 Smoking within the building is not permitted.

#### **1.31 System of Measurement**

- .1 The metric system of measurement (SI) will be employed on this Contract.

**1.32 Familiarization with Site**

- .1 Before submitting tender, visit site – as indicated in tender documents and become familiar with all conditions likely to affect the cost of the Work.

**1.33 Submission of Tender**

- .1 Submission of a tender is deemed to be confirmation of the fact that the Tenderer has analyzed the Contract documents and inspected the site, and is fully conversant with all conditions.

**END OF SECTION**

## **1 GENERAL**

**1.1 No work on the site can begin until contract award date. The contractor will have 24 hour access to the Combined Services Building in unrestricted areas on normal work days. Between the hours of 7:30 to 16:00, staff will be present to escort contractors to restricted areas. Before or after these hours, a Commissionaire is required to be present with the contractors to access restricted areas.**

### **1.2 Access and Egress**

- .1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.

### **1.3 Use of Site and Facilities**

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate work as stated.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Departmental Representative will assign sanitary facilities for use by Contractor's personnel. Keep facilities clean.
- .4 Use only designated entrances and exits to existing building for moving workers and material.
  - .1 Protect walls.
  - .2 Accept liability for damage and safety of new and existing equipment
- .5 Closures: protect work temporarily until permanent enclosures are completed.

### **1.4 Building Smoking Environment**

- .1 Comply with smoking restrictions. Smoking is not permitted.

### **1.5 Security**

- .1 Where security has been reduced by Work of Contract, provide temporary means to maintain security.
- .2 Security Escort:
  - .1 All personnel engaged for the work on this project must be escorted by a Commissionaire (Security Escort) when accessing restricted areas of both buildings after normal working hours 7:30 to 16:00. No commissionaire is required during normal working hours between 7:30 to 16:00 hours as staff will act as escort.
  - .2 Submit an Escort Request to PWGCS by email at least 48 hours before service is needed using the electronic form Attachment to Call-Up for Commissionaire Services; a hard copy will be provided. For requests submitted within the time noted above, escort will be arranged by the Department Representative and costs will be tabulated for settlement with the Contractor. Refer to Item .7.

- .3 Any escort request may be cancelled free of charge if notification of cancellation is given at least 4 hours before the scheduled time of escort.
- .4 Calculation of costs will be based on average hourly rate of security officer for minimum of 8 hours per day for late service request and 4 hours for late cancellations.
- .5 Escort security services to be Commissionaires BC.
  - .1 Charge-out hourly rates for regular federal work by Commissionaires BC are as follows:

.1	Regular Rate	-	\$24.76
.2	Regular Overtime Rate	-	\$35.16
.3	Double Overtime Rate	-	\$45.56
.4	Stat Holiday Rate		\$55.96

Rates are subject to change. Confirm current rates with The Commissionaires of B.C. at the time of contracting.

- .2 Overtime is charged after 8 hours, double overtime after 12 hours.
- .6 Contractor to identify the amount carried for Commissionaire Services in the Contract Cost Breakdown.
- .7 The Owner will hire and pay for the Commissionaires directly but the Contractor will allow for all Commissionaire costs in their contract price. When the final cost is known, the Owner will then issue a credit change order for that cost.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Administrative**

- .1 Schedule and administer project meetings throughout the progress of the work at the call of Departmental Representative.
- .2 Prepare agenda for meetings.
- .3 Distribute written notice of each meeting 7 days in advance of meeting date to Departmental Representative.
- .4 Provide physical space and make arrangements for meetings.
- .5 Preside at meetings.
- .6 Record the meeting minutes; include significant proceedings and decisions; identify actions by parties.
- .7 Reproduce and distribute copies of minutes within 3 days after meetings and transmit to meeting participants, affected parties not in attendance, and Departmental Representative.
- .8 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

### **1.2 Preconstruction Meeting**

- .1 Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Departmental Representative, Contractor, major Subcontractors, and supervisors will be in attendance.
- .3 Establish time and location of meeting and notify parties concerned minimum 5 days before meeting.
- .4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.
- .5 Agenda to include:
  - .1 Appointment of official representative of participants in the Work.
  - .2 Schedule of Work: - Construction Progress Schedule - Critical Path Method (CPM) - Construction Progress Schedules - Bar (GANNT) Chart.
  - .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 – Submittal Procedures.
  - .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences.
  - .5 Delivery schedule of specified equipment.
  - .6 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
  - .7 Owner provided products.
  - .8 Record drawings.
  - .9 Maintenance manuals.



- .10 Take-over procedures, acceptance, warranties.
- .11 Monthly progress claims, administrative procedures, photographs, hold backs.
- .12 Appointment of inspection and testing agencies or firms.
- .13 Insurances, transcript of policies.

### **1.3 Progress Meetings**

- .1 During course of Work and 2 weeks prior to project completion, schedule progress meetings bi-weekly.
- .2 Contractor, major Subcontractors involved in Work and Departmental Representative are to be in attendance.
- .3 Notify parties a minimum 7 days prior to meetings.
- .4 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within 3 days after meeting.
- .5 Agenda to include the following:
  - .1 Review, approval of minutes of previous meeting.
  - .2 Review of Work progress since previous meeting.
  - .3 Field observations, problems, conflicts.
  - .4 Problems which impede construction schedule.
  - .5 Review of off-site fabrication delivery schedules.
  - .6 Corrective measures and procedures to regain projected schedule.
  - .7 Revision to construction schedule.
  - .8 Progress schedule, during succeeding work period.
  - .9 Review submittal schedules: expedite as required.
  - .10 Maintenance of quality standards.
  - .11 Review proposed changes for effect on construction schedule and on completion date.
  - .12 Other business.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Related Requirements**

- .1 Section 01 33 13 – Special Procedures for Airport Facilities.

### **1.2 Restricted or Secure Area**

- .1 Any area on airport property to which access is restricted by sign and/or monitored is a secure or restricted area.
- .2 In general, access to the airside of the Airport is restricted to the access points indicated on the drawings or as subsequently approved by the Airport Manager. All personnel and vehicles entering or leaving the construction site must follow prescribed access routes and be under escort or surveillance. The need for an escort may be waived by the Departmental Representative should the contractor complete the necessary on-site safety orientation & briefing session with the airport manager prior to commencement of work.
- .3 Security measures shall be taken at the Contractor's expense to meet the Airport's security requirements.
- .4 The Departmental representative, or the airport manager, may, for security reasons, remove all of the Contractor's workforce from the Airport at any time. No assessment for temporary "Stop Work" periods will be payable by Transport Canada.

### **1.3 Contractor's Responsibility**

- .1 General Contractor and subcontractor shall be responsible for construction personnel and vehicles employed on the project and requiring access to restricted areas.
- .2 All Contract personnel and equipment must remain within designated work areas at all times.
- .3 The Contractor shall be responsible for the security of his/her own equipment and materials.

### **1.4 Passes and Keys**

- .1 Passes are mandatory on airside and other restricted areas for all personnel engaged in work and are subject to airport restricted area access clearance.
- .2 Personnel requiring access to restricted area must be escorted by a designated commissionaire after normal working hours.
- .3 Permanent passholders – Commissionaires shall provide ESCORT and SURVEILLANCE to temporary passholders.
- .4 Temporary passes will be issued at beginning and returned at end of each working day. Their safekeeping will be responsibility of Contractor.
- .5 On completion of project, passes will be returned to the Departmental Representative. A charge of \$500.00 will be issued for each pass not returned.

### **1.5 Responsible Personnel**

- .1 Provide the Departmental Representative with a list of responsible personnel and phone numbers who may be contacted after working hours in case of emergency.

### **1.6 Deliveries**

- .1 Any delivery vehicle required to encroach on aircraft movement/manoeuvring areas not close to aircraft traffic must comply with the requirements of Section 01 33 13 Special Procedures for Airport Facilities.
- .2 Escort vehicle and trained escort personnel must be provided by Contractor.

### **1.7 Existing Security Barriers**

- .1 Security barriers, such as doors, fences, gates, locks, or door hardware, which are required to be removed, must be replaced, if practicable, at the end of each work day. If it is necessary to remove barriers for an extended period, enclose unprotected areas with temporary hoarding.

Where the possibility exists that a restricted area may be left unprotected at the end of the work day, inform the Departmental Representative immediately.

- .2 Failure to restore such security barriers when required will result in their restoration by other forces and the cost of such restoration being recovered from the Contractor.

### **1.8 Daily Security**

- .1 Ensure that access to restricted areas is in the presence of the Department Representative or Commissionaire.
- .2 When work is to be done within a restricted area after scheduled working hours, notify the Departmental Representative of area and times.
- .3 The Contractor shall follow the Departmental Representative's instructions to maintain security during all phases of construction. Any work required to restore the site security will be carried out at the Contractor's expense.

**END OF SECTION**

## 1.1 Approvals

- .1 Approval of shop drawings and samples: refer to Section 01 11 55 – General Instructions.

## 1.2 General

- .1 This Section specifies general requirements and procedures for the Contractor's submissions of shop drawings, product data, samples and other requested submittals to Departmental Representative for review. Additional specific requirements for submissions are specified in individual technical sections.
- .2 Present shop drawings, product data and samples in SI Metric units.
- .3 Where items or information is not produced in SI Metric units, converted values are acceptable.
- .4 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submissions.
- .5 Notify Departmental Representative in writing at time of submission, identifying deviations from requirements of Contract documents and stating reasons for deviations.
- .6 Contractor's responsibility for deviations in submission from requirements of Contract documents is not relieved by Departmental Representative's review of submission unless Departmental Representative gives written acceptance of specific deviations.
- .7 Make any changes in submissions which Departmental Representative may require consistent with Contract documents and resubmit as directed by Departmental Representative.
- .8 Notify Departmental Representative in writing, when resubmitting, of any revisions other than those requested by Departmental Representative.
- .9 Do not proceed with work until relevant submissions are reviewed and approved by the Departmental Representative.

## 1.3 Submission Requirements

- .1 Coordinate each submission with the requirements of the work and the Contract documents. Individual submissions will not be reviewed until all related information is available.
- .2 Allow (5) five days for Departmental Representative's review of each submission, unless noted otherwise.
- .3 Accompany submissions with transmittal letter, in duplicate, containing:
  - .1 Date.
  - .2 Project title and number.
  - .3 Contractor's name and address.
  - .4 Identification and quantity of each shop drawing, product data and sample.
  - .5 Other pertinent data.
- .4 Submissions shall include:
  - .1 Date and revision dates.
  - .2 Project title and number.

- .3 Name and address of:
  - .1 Subcontractor.
  - .2 Supplier.
  - .3 Manufacturer.
- .4 Contractor's stamp, signed by Contractor's authorized representative, certifying approval of submissions, verification of field measurements and compliance with Contract documents.
- .5 Details of appropriate portions of work as applicable.
  - .1 Fabrication.
  - .2 Layout, showing dimensions (including identified field dimensions and clearances).
  - .3 Setting or erection details.
  - .4 Capacities.
  - .5 Performance characteristics.
  - .6 Standards.
  - .7 Operating weight.
  - .8 Wiring diagrams.
  - .9 Single line and schematic diagrams.
  - .10 Relationship to adjacent work.
- .6 After Departmental Representative's review, distribute copies.

#### **1.4 Shop Drawings**

- .1 Shop drawings: original drawings or modified standard drawings provided by Contractor to illustrate details of portion of work which are specific to project requirements.
- .2 Maximum sheet size: 850 x 1050 mm.
- .3 Submit 6 prints of shop drawings for each requirement requested in the specification sections and/or as requested by the Departmental Representative.
- .4 Cross-reference shop drawing information to applicable portions of the Contract documents.

#### **1.5 Shop Drawings Review**

- .1 Review of shop drawings by Public Works and Government Services Canada is for the sole purpose of ascertaining conformance with the general concept.
- .2 This review shall not mean that Public Works and Government Services Canada approves the detail design inherent in the shop drawings, responsibility for which shall remain with Contractor submitting same.
- .3 This review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the construction and Contract documents.
- .4 Without restricting the generality of the foregoing, the Contractor is responsible for:
  - .1 Dimensions to be confirmed and correlated at the job site.
  - .2 Information that pertains solely to fabrication processes or to techniques of construction and installation.

- .3 Coordination of the work of all sub-trades.

#### **1.6 Product Data**

- .1 Product data: manufacturers' catalogue sheets, MSDS sheets, brochures, literature, performance charts and diagrams, used to illustrate standard manufactured products or any other specified information.
- .2 Delete information not applicable to project.
- .3 Supplement standard information to provide details applicable to project.
- .4 Cross-reference product data information to applicable portions of Contract documents.
- .5 Submit 6 copies of product data.

#### **1.7 Samples**

- .1 Samples: examples of materials, equipment, quality, finishes and workmanship.
- .2 Where colour, pattern or texture is a criterion, submit a full range of samples.
- .3 Reviewed and accepted samples will become the standard of workmanship and material against which installed work will be verified.

#### **1.8 Progress Schedule**

- .1 Submit work schedule and cost breakdown as required in Section 01 11 55 – General Instructions.

#### **1.9 Test Results and Inspection Reports**

- .1 Submit in duplicate test results and inspection reports.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Related Sections**

- .1 Section 01 56 00 Temporary Barriers and Enclosures.

### **1.2 General Protection**

- .1 Do not disrupt airport business except as permitted by Departmental Representative.
- .2 Provide temporary protection for safe handling of public, personnel, pedestrians and vehicular traffic: to Section 01 56 00 - Temporary Barriers and Enclosures.
- .3 Provide barricades and lights where directed by Departmental Representative.

### **1.3 Movement of Equipment and Personnel**

- .1 In areas of airport not closed to aircraft traffic:
  - .1 Obtain Departmental Representative's approval on scheduling of Work.
  - .2 Control movements of equipment and personnel as directed by Departmental Representative.
  - .3 Provide qualified field personnel at locations designated by Departmental Representative to relay signals from airport traffic control tower to equipment and personnel wishing to cross live traffic areas.
  - .4 Immediately obey signals from airport traffic control tower.

### **1.4 Unserviceable areas**

- .1 Mark off areas made unserviceable for aircraft by Work of this Contract by providing highly visible danger markings by day and red lights by night.
- .2 Open flames and flammable fuels are not permitted.
- .3 Park equipment not in use and stockpile materials so that stockpile tops are below 50 to 1 ratio from ends of useable landing strip and below 20 to 1 ratio from sides of aircraft traffic areas.
  - .1 Mark tops with red lights as directed by Departmental Representative.

### **1.5 Trenching**

- .1 Obtain Departmental Representative's written permission to undertake trenching on pavements open to aircraft traffic which cannot be completed, backfilled and sealed within 1 working day.

### **1.6 Airport Facilities**

- .1 Departmental Representative will stake or indicate location of underground facilities such as cables, pipes, ducts and other services and utilities.
- .2 Notify Departmental Representative of work areas 48 hours minimum in advance of operations to allow sufficient time for underground facilities and service to be located.

**2 PRODUCTS**

**2.1 Not Used**

.1 Not Used.

**3 EXECUTION**

**3.1 Not Used**

.1 Not Used.

**END OF SECTION**



## **1 GENERAL**

### **1.1 References**

- .1 Government of Canada:
  - .1 Canada Labour Code – Part 2
  - .2 Canada Occupational Health and Safety Regulations.
- .2 National Building Code of Canada (NBC):
  - .1 Part 8, Safety Measures at Construction and Demolition Sites.
- .3 Canadian Standards Association (CSA): as amended:
  - .1 CSA Z797-2009 Code of Practice for Access Scaffold.
  - .2 CSA S269.1-1975 (R2003) Falsework for Construction Purposes.
  - .3 CSA-S350-M1980 (R2003), Code of Practice for Safety in Demolition of Structures.
- .4 Fire Protection Engineering Services, HRSDC:
  - .1 FCC No. 301, Standard for Construction Operations.
  - .2 FCC No. 302, Standard for Welding and Cutting.
- .5 American National Standards Institute (ANSI):
  - .1 ANSI A10.3, Operations – Safety Requirements for Powder-Actuated Fastening Systems.
- .6 Province of British Columbia:
  - .1 Workers' Compensation Act Part 3 - Occupational Health and Safety.
  - .2 Occupational Health and Safety Regulation.
  - .3 Current BC Electrical Code.
- .7 National Fire Code of Canada 2010 (as amended)
  - .1 Part 5 – Hazardous Processes and Operations and Division B as applicable and required.

### **1.2 Related Sections**

- |    |  |                  |
|----|--|------------------|
| .1 | Summary of Work                        | Section 01 11 00 |
| .2 | General Instructions                   | Section 01 11 55 |
| .3 | Project Meetings                       | Section 01 31 19 |
| .4 | Shop Drawings, Product Data & Samples  | Section 01 33 00 |
| .5 | Special Procedures for Airports in Use | Section 01 35 13 |
| .6 | Health and Safety Requirements         | Section 01 35 33 |
| .7 | Hazmat Building Materials Assessment   | Appendix B       |

### **1.3 Worker's Compensation Board Coverage**

- .1 Comply fully with the Workers' Compensation Act, regulations and orders made pursuant thereto, and any amendments up to the completion of the work.
- .2 Maintain Workers' Compensation Board coverage during the term of the Contract, until and including the date that the Certificate of Final Completion is issued.

### **1.4 Compliance with Regulations**

- .1 PWGSC may terminate the Contract without liability to PWGSC where the Contractor, in the opinion of PWGSC, refuses to comply with a requirement of the Workers' Compensation Act or the Occupational Health and Safety Regulations.
- .2 It is the Contractor's responsibility to ensure that all workers are qualified, competent and certified to perform the work as required by the Workers' Compensation Act or the Occupational Health and Safety Regulations

### **1.5 Submittals**

- .1 Submit to Departmental Representative submittals listed for review in accordance with Section 01 33 00 – Shop Drawings, Product Data & Samples.
- .2 Work effected by submittal shall not proceed until review is complete.
- .3 Submit the following:
  - .1 Health and Safety Plan: within 7 days after date of Notice to Proceed and prior to commencement of Work.
  - .2 Fire Safety Plan: Within 10 working days after date of Notice to Proceed and prior to commencement of Work.
  - .3 Copies of reports or directions issued by Federal and Provincial health and safety inspectors.
  - .4 Copies of incident and accident reports.
  - .5 Submit Material Safety Data Sheets (MSDS), and all other documentation required by Workplace Hazardous Materials Information System (WHMIS) requirements.
  - .6 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.
- .4 The Departmental Representative will review the Contractor's site-specific project Health and Safety Plan and emergency procedures, and provide comments to the Contractor within 2 days after receipt of the plan. Revise the plan as appropriate and resubmit to Departmental Representative.
- .5 Medical surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of work, and submit additional certifications for any new site personnel to Departmental Representative.
- .6 Submission of the Health and Safety Plan, and any revised version, to the Departmental Representative is for information and reference purposes only. It shall not:
  - .1 Be construed to imply approval by the Departmental Representative.
  - .2 Be interpreted as a warranty of being complete, accurate and legislatively compliant.

- .3 Relieve the Contractor of his legal obligations for the provision of health and safety on the project.

#### **1.6 Responsibility**

- .1 Assume responsibility as the Prime Contractor for work under this contract.
- .2 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .3 Comply with and enforce compliance by employees with safety requirements of Contract documents, applicable Federal, Provincial, Territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

#### **1.7 Health and Safety Coordinator**

- .1 The Health and Safety Coordinator must:
  - .1 Be responsible for completing all health and safety training, and ensuring that personnel that do not successfully complete the required training are not permitted to enter the site to perform work.
  - .2 Be responsible for implementing, daily enforcing, and monitoring the site-specific Health and Safety Plan.
  - .3 Be on site during execution of work.

#### **1.8 General Conditions**

- .1 Provide safety barricades and lights around work site as required to provide a safe working environment for workers and protection for pedestrian and vehicular traffic.
- .2 Ensure that non-authorized persons are not allowed to circulate in designated construction areas of the work site.
  - .1 Provide appropriate means by use of barricades, fences, warning signs, traffic control personnel, and temporary lighting as required.
  - .2 Secure site at night time or provide security guard as deemed necessary to protect site against entry.

#### **1.9 Project Site Conditions**

- .1 Work at site will involve contact with:
  - .1 Multiple employer worksites.
  - .2 Unpredictable weather conditions.
  - .3 Vehicular and air traffic.
  - .4 Noise.
- .2 Hazmat Assessment Report for Combined Services Building included in Appendix B.

#### **1.10 Regulatory Requirements**

- .1 Comply with specified codes, acts, bylaws, standards and regulations to ensure safe operations at site.
- .2 In event of conflict between any provision of the above authorities, the most stringent provision will apply. Should a dispute arise in determining the most stringent

requirement, the Departmental Representative will advise on the course of action to be followed.

### **1.11 Work Permits**

- .1 Obtain specialty permits related to project before start of work.

### **1.12 Filing of Notice**

- .1 The General Contractor is to complete and submit a Notice of Project as required by Provincial authorities.
- .2 Provide copies of all notices to the Departmental Representative.

### **1.13 Health and Safety Plan**

- .1 Conduct a site-specific hazard assessment based on review of Contract documents, required work, and project site. Identify any known and potential health risks and safety hazards.
- .2 Prepare and comply with a site-specific project Health and Safety Plan based on hazard assessment, including, but not limited to, the following:
  - .1 Primary requirements:
    - .1 Contractor's safety policy.
    - .2 Identification of applicable compliance obligations.
    - .3 Definition of responsibilities for project safety/organization chart for project.
    - .4 General safety rules for project.
    - .5 Job-specific safe work, procedures.
    - .6 Inspection policy and procedures.
    - .7 Incident reporting and investigation policy and procedures.
    - .8 Occupational Health and Safety Committee/Representative procedures.
    - .9 Occupational Health and Safety meetings.
    - .10 Occupational Health and Safety communications and record keeping procedures.
  - .2 Summary of health risks and safety hazards resulting from analysis of hazard assessment, with respect to site tasks and operations which must be performed as part of the work.
  - .3 List hazardous materials to be brought on site as required by work.
  - .4 Indicate engineering and administrative control measures to be implemented at the site for managing identified risks and hazards.
  - .5 Identify personal protective equipment (PPE) to be used by workers.
  - .6 Identify personnel and alternates responsible for site safety and health.
  - .7 Identify personnel training requirements and training plan, including site orientation for new workers.
- .3 Develop the plan in collaboration with all subcontractors. Ensure that work/activities of subcontractors are included in the hazard assessment and are reflected in the plan.
- .4 Revise and update Health and Safety Plan as required, and re-submit to the Departmental Representative.

- .5 Departmental Representative's review: the review of Health and Safety Plan by Public Works and Government Services Canada (PWGSC) shall not relieve the Contractor of responsibility for errors or omissions in final Health and Safety Plan or of responsibility for meeting all requirements of construction and Contract documents.

#### **1.14 Emergency Procedures**

- .1 List standard operating procedures and measures to be taken in emergency situations. Include an evacuation plan and emergency contacts (i.e. names/telephone numbers) of:
  - .1 Designated personnel from own company.
  - .2 Regulatory agencies applicable to work and as per legislated regulations.
  - .3 Local emergency resources and
  - .4 Departmental Representative and site staff.
- .2 Include the following provisions in the emergency procedures:
  - .1 Notify workers and the first-aid attendant, of the nature and location of the emergency.
  - .2 Evacuate all workers safely.
  - .3 Check and confirm the safe evacuation of all workers.
  - .4 Notify the fire department or other emergency responders.
  - .5 Notify adjacent workplaces or residences which may be affected if the risk extends beyond the workplace.
  - .6 Notify Departmental Representative and site staff.
- .3 Provide written rescue/evacuation procedures as required for, but not limited to:
  - .1 Work at high angles.
  - .2 Work in confined spaces or where there is a risk of entrapment.
  - .3 Work with hazardous substances.
  - .4 Underground work.
  - .5 Work on, over, under and adjacent to water.
  - .6 Workplaces where there are persons who require physical assistance to be moved.
- .4 Design and mark emergency exit routes to provide quick and unimpeded exit.
- .5 Revise and update emergency procedures as required, and re-submit to the Departmental Representative.

#### **1.15 Hazardous Products**

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials, and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to the Departmental Representative and in accordance with the Canada Labour Code.
- .2 Where use of hazardous and toxic products cannot be avoided:
  - .1 Advise Departmental Representative beforehand of the product(s) intended for use. Submit applicable MSDS and WHMIS documents as per Section 01 33 00.
  - .2 In conjunction with Departmental Representative, schedule to carry out work during "off hours" when tenants have left the building.

- .3 Provide adequate means of ventilation in accordance with Section 01 51 00.

#### **1.16 Asbestos Hazard**

- .1 Carry out work or demolition activities involving asbestos in accordance with Provincial regulations.

#### **1.17 PCB Removals**

- .1 Mercury-containing fluorescent tubes and ballasts which contain polychlorinated biphenyls (PCBs) are classified as hazardous waste.
- .2 Remove, handle, transport and dispose of as per Provincial regulations.

#### **1.18 Removal of Lead-Containing Paint**

- .1 All paints containing TCLP lead concentrations above 5 ppm are classified as hazardous.
- .2 Carry out demolition activities involving lead-containing paints in accordance with applicable Provincial regulations.

#### **1.19 Electrical Safety Requirements**

- .1 Comply with authorities and ensure that, when installing new facilities or modifying existing facilities, all electrical personnel are completely familiar with existing and new electrical circuits and equipment and their operation.
  - .1 Before undertaking any work, coordinate required energizing and de-energizing of new and existing circuits with Departmental Representative.
  - .2 Maintain electrical safety procedures and take necessary precautions to ensure safety of all personnel working under this Contract, as well as safety of other personnel on site.

#### **1.20 Electrical Lockout**

- .1 Develop, implement and enforce use of established procedures to provide electrical lockout and to ensure the health and safety of workers for every event where work must be done on any electrical circuit or facility.
- .2 Prepare the lockout procedures in writing, listing step-by-step processes to be followed by workers, including how to prepare and issue the request / authorization form. Have procedures available for review upon request by the Departmental Representative.
- .3 Keep the documents and lockout tags at the site and list in a log book for the full duration of the Contract. Upon request, make such data available for viewing by Departmental Representative or by any authorized safety representative.

#### **1.21 Overloading**

- .1 Ensure no part of work is subjected to a load which will endanger its safety or will cause permanent deformation.

#### **1.22 Falsework**

- .1 Design and construct falsework in accordance with CSA S269.1-1975 (R2003).

### **1.23 Scaffolding**

- .1 Design, construct and maintain scaffolding in a rigid, secure and safe manner, in accordance with CSA Z797-2009 and B.C. Occupational Health and Safety Regulations.

### **1.24 Confined Spaces**

- .1 Carry out work in confined spaces in compliance with provincial regulations.
- .2 Comply with Canada Occupational Health and Safety Regulation, Part 9.

### **1.25 Powder-Actuated Devices**

- .1 Use powder-actuated devices in accordance with ANSI A10.3 only after receipt of written permission from the Departmental Representative.

### **1.26 Fire Safety and Hot Work**

- .1 Obtain Departmental Representative's authorization before any welding, cutting or any other hot work operations can be carried out on site.
- .2 Hot work includes cutting/melting with use of torch, flame heating roofing kettles, or other open flame devices and grinding with equipment which produces sparks.

### **1.27 Fire Safety Requirements**

- .1 Store oily/paint-soaked rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
- .2 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

### **1.28 Fire Protection and Alarm System**

- .1 Fire protection and alarm systems shall not be:
  - .1 Obstructed.
  - .2 Shut off.
  - .3 Left inactive at the end of a working day or shift.
- .2 Do not use fire hydrants, standpipes and hose systems for purposes other than firefighting.
- .3 Be responsible/liable for costs incurred from the fire department, the building owner and the tenants, resulting from false alarms.

### **1.29 Unforeseen Hazards**

- .1 Should any unforeseen or peculiar safety-related factor, hazard or condition become evident during performance of the work, immediately stop work and advise the Departmental Representative verbally and in writing.

### **1.30 Posted Documents**

- .1 Post legible versions of the following documents on site:
  - .1 Health and Safety Plan.
  - .2 Sequence of work.

- .3 Emergency procedures.
  - .4 Site drawing showing project layout, locations of the first-aid station, evacuation route and marshalling station, and the emergency transportation provisions.
  - .5 Notice of Project.
  - .6 Floor plans or site plans.
  - .7 Notice as to where a copy of the Workers' Compensation Act and Regulations are available on the work site for review by employees and workers.
  - .8 Workplace Hazardous Materials Information System (WHMIS) documents.
  - .9 Material Safety Data Sheets (MSDS).
  - .10 List of names of Joint Health and Safety Committee members, or Health and Safety Representative, as applicable.
- .2 The General Contractor to include the name of the "qualified coordinator responsible for the coordination of health and safety activities" in accordance with Section 118 of the Workers' Compensation Act.
  - .3 Post all Material Safety Data Sheets (MSDS) on site, in a common area, visible to all workers and in locations accessible to tenants when work of this Contract includes construction activities adjacent to occupied areas.
  - .4 Postings should be protected from the weather, and visible from the street or the exterior of the principal construction site shelter provided for workers and equipment, or as approved by the Departmental Representative.

### **1.31 Meetings**

- .1 Attend health and safety pre-construction meeting and all subsequent meetings called by the Departmental Representative.

### **1.32 Correction of Non-Compliance**

- .1 Immediately address health and safety non-compliance issues identified by the Departmental Representative.
- .2 Provide Departmental Representative with written report of action taken to correct non-compliance with health and safety issues identified.
- .3 The Departmental Representative may issue a "stop work order" if non-compliance of health and safety regulations is not corrected immediately or within posted time. The General Contractor/subcontractors will be responsible for any costs arising from such a "stop work order".

**END OF SECTION**



## **1 GENERAL**

### **1.1 References**

- .1 Definitions:
  - .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.
  - .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.
- .2 Reference Standards:
  - .1 Canadian Construction Documents Committee (CCDC)
    - .1 CCDC 2-2008 Stipulated Price Contract.

### **1.2 Related Sections**

- .1 Hazmat Building Materials Assessment Appendix B

### **1.3 Action and Informational Submittals**

- .1 Submit in accordance with Section 01 33 00 – Shop Drawings, Product Data and Samples.
- .2 Before commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review and approval by Departmental Representative.
- .3 Environmental Protection Plan must include comprehensive overview of known or potential environmental issues to be addressed during construction.
- .4 Address topics at level of detail commensurate with environmental issue and required construction tasks.
- .5 Include in Environmental Protection Plan:
  - .1 Names of persons responsible for ensuring adherence to Environmental Protection Plan.
  - .2 Names and qualifications of persons responsible for manifesting hazardous waste to be removed from site.
  - .3 Names and qualifications of persons responsible for training site personnel.
  - .4 Descriptions of environmental protection personnel training program.
  - .5 Erosion and sediment control plan identifying type and location of erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
  - .6 Drawings indicating locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures,

sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.

- .7 Traffic Control Plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather.
  - .1 Plans to include measures to minimize amount of material transported onto paved public roads by vehicles or runoff.
- .8 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use.
  - .1 Plan to include measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.
- .9 Spill Control Plan to include procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
- .10 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
- .11 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.
- .12 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.
- .13 Waste Water Management Plan identifying methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.
- .14 Historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands.
- .15 Pesticide treatment plan to be included and updated, as required.

#### **1.4 Fires**

- .1 Fires and burning of rubbish on site is not permitted
- .2 Provide supervision, attendance and fire protection measures as directed.

#### **1.5 Drainage**

- .1 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

#### **1.6 Notification**

- .1 Departmental Representative will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.

- .2 Contractor: after receipt of such notice, inform Departmental of proposed corrective action and take such action for approval by Departmental Representative.
  - .1 Take action only after receipt of written approval by Departmental Representative.
- .3 Departmental Representative will issue stop order of work until satisfactory corrective action has been taken.
- .4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

## **2 PRODUCTS**

### **2.1 Not Used**

## **3 EXECUTION**

### **3.1 Cleaning**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave work area clean at end of each day.
- .2 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.
- .3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .4 Waste Management: separate waste materials in accordance with Section 01 74 19 -Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Related Requirements**

- .1 General Instructions Section 01 11 55

### **1.2 References and Codes**

- .1 Perform Work in accordance with National Building Code of Canada (NBC) 2010 including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .2 Meet or exceed requirements of:
  - .1 Contract documents.
  - .2 Specified standards, codes and referenced documents.

### **1.3 Hazardous Material Discovery**

- .1 Asbestos: demolition of spray or trowel-applied asbestos is hazardous to health. Stop work immediately when material resembling spray or trowel-applied asbestos is encountered during demolition work. Notify Departmental Representative.
- .2 Mould: stop work immediately when material resembling mould is encountered during demolition work. Notify Departmental Representative.

### **1.4 Building Smoking Environment**

- .1 Comply with smoking restrictions and municipal by-laws.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Inspection**

- .1 Allow Departmental Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative instructions, or law of Place of Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .4 Departmental Representative will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Departmental Representative shall pay cost of examination and replacement.

### **1.2 Independent Inspection Agencies**

- .1 Independent Inspection/Testing Agencies will be engaged by Departmental Representative for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Departmental Representative.
- .2 Provide equipment required for executing inspection and testing by appointed agencies.
- .3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to Departmental Representative. Pay costs for retesting and re-inspection.

### **1.3 Access**

- .1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.
- .2 Co-operate to provide reasonable facilities for such access.

### **1.4 Procedures**

- .1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.

- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

### **1.5 Rejected Work**

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If in opinion of Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Department Representative.

### **1.6 Reports**

- .1 Submit electronic copies of inspection and test reports to Departmental Representative.
- .2 Provide copies to subcontractor of work being inspected or tested or manufacturer or fabricator of material being inspected or tested.

### **1.7 Tests and Mix Designs**

- .1 Furnish test results and mix designs as requested.
- .2 Cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work will be appraised by Departmental Representative and may be authorized as recoverable.

### **1.8 Mock Ups**

- .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.
- .2 Construct in locations acceptable to Departmental Representative as specified in specific sections.
- .3 Prepare mock-ups for Departmental Representative review with reasonable promptness and in orderly sequence, to not cause delays in Work.
- .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .5 If requested, Departmental Representative will assist in preparing schedule fixing dates for preparation.
- .6 Remove mock-up at conclusion of Work or when acceptable to Departmental Representative.
- .7 Mock-ups may remain as part of Work.

- .8 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed and when.

**1.9 Equipment and Systems**

- .1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.
- .2 Refer to Divisions 22, 23 and 25 for definitive requirements.

**END OF SECTION**

## **1 GENERAL**

### **1.1 References**

- .1 Canada Standards Association (CSA International)
  - .1 CAN/CSA-Z321-[96(R2001)], Signs and Symbols for the Occupational Environment.

### **1.2 Access and Delivery**

- .1 Department Representative to confirm which entrance may be used for access to building.
  - .1 Maintain for duration of Contract.
  - .2 Make good damage resulting from Contractor's use.
- .2 All contractors are required to use only the loading dock entrance.

### **1.3 Storage Facilities**

- .1 Transport Canada will provide exterior, on-site, space for outside equipment/a material storage trailer/a sea container, as required by the contractor.

### **1.4 Power**

- .1 Electrical power and lighting at existing building may be used for construction purposes at no extra cost, provided that warranties are not affected thereby and electrical components used for temporary power are replaced when damaged. Do not use emergency power or UPS panels for this purpose.

### **1.5 Water Supply**

- .1 Water supply is available at existing building and may be used for construction purposes at no cost.

### **1.6 Sanitary Facilities**

- .1 Existing designated washroom facilities may be used on approval of Departmental Representative. Clean and stock washroom daily and before final completion.

### **1.7 Heating and Ventilation**

- .1 Do not begin work until arrangements have been made with the Departmental Representative for protection of the existing systems.
  - .1 If there is any dirt in the heating and ventilation system, it will be the Contractor's responsibility to return it to its original state in accordance with the Departmental Representative's specifications.
- .2 Prevent dust and odour migration to other occupied areas.
  - .1 Do not activate HVAC system to occupied floors. Purge air from construction floors only when directed by Departmental Representative, where dust and fumes will be generated.
  - .2 Change filters in existing HVAC system frequently.



**1.8 Scaffolding**

- .1 Construct and maintain scaffolding in rigid, secure and safe manner.
- .2 Erect scaffolding independent of walls. Remove promptly when no longer required.

**1.9 Removal and Temporary Facilities**

- .1 Remove temporary facilities from site when directed by the Departmental Representative.

**1.10 Signs and Notices**

- .1 Signs and notices for safety and instruction shall be in both official languages or graphic symbols conforming to CAN/CSA-Z321.
- .2 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or when directed by Departmental Representative.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Related Sections**

- .1 Section 01 32 19 Security

### **1.2 References**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB 1.189-[00], Exterior Alkyd Primer for Wood.
  - .2 CGSB 1.59-[97], Alkyd Exterior Gloss Enamel.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA-A23.1/A23.2-[04], Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA-0121-[M1978(R2003)], Douglas Fir Plywood.
  - .3 CAN/CSA-S269.2-[M1987(R2003)], Access Scaffolding for Construction Purposes.
  - .4 CAN/CSA-Z321-[96(R2001)], Signs and Symbols for the Occupational Environment.
- .3 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as of: May 14, 2004.

### **1.3 Action and Informational Submittals**

- .1 Provide submittals in accordance with Section 01 33 00 – Shop Drawings, Product Data & Samples.

### **1.4 Installation and Removal**

- .1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.
- .2 Identify areas which have to be gravelled to prevent tracking of mud.
- .3 Indicate use of supplemental or other staging area.
- .4 Provide construction facilities in order to execute work expeditiously.
- .5 Remove from site all such work after use.

### **1.5 Scaffolding**

- .1 Scaffolding in accordance with CAN/CSA-S269.2.
- .2 Provide and maintain scaffolding, ladders and platforms.

### **1.6 Hoisting**

- .1 Provide, operate and maintain hoists cranes required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for their use of hoists.

- .2 Hoists cranes to be operated by qualified operator.

### **1.7 Site Storage/Loading**

- .1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
- .2 Do not load or permit to load any part of Work with weight or force that will endanger Work.

### **1.8 Construction Parking**

- .1 Parking will be permitted on site provided it does not disrupt performance of Work.
- .2 Provide and maintain adequate access to project site.
- .3 Clean runways and taxi areas where used by Contractor's equipment.

### **1.9 Security**

- .1 Provide and pay for responsible security personnel to guard site and contents of site after working hours and during holidays.
- .2 Refer to Section 01 32 19 – Security for further details.

### **1.10 Offices**

- .1 Provide office of sufficient size to accommodate site meetings and furnished with drawing laydown table.
- .2 Provide marked and fully stocked first-aid case in a readily available location.
- .3 Subcontractors to provide their own offices as necessary. Direct location of these offices.

### **1.11 Equipment, Tools and Materials Storage**

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.

### **1.12 Sanitary Facilities**

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.

### **1.13 Construction Signage**

- .1 No other signs or advertisements, other than warning signs, are permitted on site.
- .2 Maintain approved signs and notices in good condition for duration of project, and dispose of off-site on completion of project or earlier if directed by Departmental Representative.

- .3 Signs and notices for safety and instruction shall be in both official languages or graphic symbols conforming to CAN/CSA-Z321.

#### **1.14 Protection and Maintenance of Traffic**

- .1 Provide access and temporary relocated roads as necessary to maintain traffic.
- .2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by Departmental Representative.
- .3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs
- .4 Protect travelling public from damage to person and property.
- .5 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.
- .7 Construct access and haul roads necessary.
- .8 Haul roads: constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided.
- .9 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .10 Dust control: adequate to ensure safe operation at all times.
- .11 Location, grade, width, and alignment of construction and hauling roads: subject to approval by Departmental Representative.
- .12 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.
- .13 Provide snow removal during period of Work.
- .14 Remove, upon completion of work, haul roads designated by Departmental Representative.

#### **1.15 Clean-Up**

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Clean dirt or mud tracked onto paved or surfaced roadways.
- .3 Store materials resulting from demolition activities that are salvageable.
- .4 Stack stored new or salvaged material not in construction facilities.

**END OF SECTION**

## **1 GENERAL**

### **1.1 References**

- .1 Canadian General Standards Board (CGSB)
  - .1 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
  - .2 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA-O121-M1978(R2003), Douglas Fir Plywood.
- .3 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as Of: May 14, 2004.

### **1.2 Installation and Removal**

- .1 Provide temporary controls in order to execute Work expeditiously.
- .2 Remove from site all such work after use.

### **1.3 Hoarding**

- .1 Erect temporary site enclosures as required.
- .2 Apply plywood panels vertically as indicated.
- .3 Erect and maintain pedestrian walkways including roof and side covers, complete with signs and electrical lighting as required by law.
- .4 Erect temporary site enclosure using new 1.2 m high snow fence wired to rolled steel "T" bar fence posts spaced at 2.4 m on centre. Provide one lockable truck gate. Maintain fence in good repair.
- .5 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.

### **1.4 Guard Rails and Barricades**

- .1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs.
- .2 Provide as required by governing authorities.

### **1.5 Weather and Enclosures**

- .1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.
- .2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.
- .3 Design enclosures to withstand wind pressure and snow loading.

**1.6 Dust Tight Screens**

- .1 Provide dust tight screens or insulated partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.
- .2 Maintain and relocate protection until such work is complete.

**1.7 Access to Site**

- .1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.

**1.8 Public Traffic Flow**

- .1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect public.

**1.9 Fire Routes**

- .1 Maintain access to property including overhead clearances for use by emergency response vehicles.

**1.10 Protection for Off-Site and Public Property**

- .1 Protect surrounding private and public property from damage during performance of Work.
- .2 Be responsible for damage incurred.

**1.11 Protection of Building Finishes**

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Confirm with Departmental Representative locations and installation schedule 3 days prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

**1.12 Waste Management Disposal**

- .1 Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**

## **1 GENERAL**

### **1.1 References**

- .1 Within text of each specifications section, reference may be made to reference standards.
- .2 Conform to these reference standards, in whole or in part as specifically requested in specifications.
- .3 If there is question as to whether products or systems are in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .4 Cost for such testing will be born by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

### **1.2 Quality**

- .1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.
- .3 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .4 Should disputes arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.
- .5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

### **1.3 Storage, Handling and Protection**

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.

- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.
- .9 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

#### **1.4 Transportation**

- .1 Pay costs of transportation of products required in performance of Work.
- .2 Transportation cost of products supplied by Owner will be paid for by Departmental Representative. Unload, handle and store such products.

#### **1.5 Manufacturer's Instructions**

- .1 Unless otherwise indicated in the specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions, so that Departmental Representative will establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Departmental Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

#### **1.6 Quality of Work**

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Departmental Representative if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Departmental Representative reserves right to require dismissal from site, workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative, whose decision is final.

#### **1.7 Co-ordination**

- .1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.



- .2 Be responsible for coordination and placement of openings, sleeves and accessories.

### **1.8 Concealment**

- .1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation inform Departmental Representative if there is interference. Install as directed by Departmental Representative.

### **1.9 Remedial Work**

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.
- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

### **1.10 Location of Fixtures**

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform Departmental Representative of conflicting installation. Install as directed.

### **1.11 Fastenings**

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

### **1.12 Fastenings - Equipment**

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

**1.13 Protection of Work in Progress**

- .1 Prevent overloading of parts of building. Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of Departmental Representative.

**1.14 Existing Utilities**

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and/or building occupants and pedestrian and vehicular traffic.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Products/Material and Equipment**

- .1 Use NEW products/material and equipment unless otherwise specified. The term “products” is referred to throughout the specifications.
- .2 Use products of 1 manufacturer for material and equipment of the same type or classification unless otherwise specified.
- .3 Unless otherwise specified, comply with manufacturer’s latest printed instructions for materials and installation methods.
- .4 Notify Departmental Representative in writing of any conflict between these specifications and manufacturer’s instructions. Departmental Representative will designate which document is to be followed.
- .5 Provide metal fastenings and accessories in the same texture, colour and finish as base metal in which they occur.
  - .1 Prevent electrolytic action between dissimilar metals.
  - .2 Use non-corrosive fasteners, anchors and spacers for securing exterior work.
- .6 Fastenings which cause spalling or cracking are not acceptable.
- .7 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .8 Use heavy hexagon heads, semi-finished unless otherwise specified.
- .9 Bolts may not project more than 1 diameter beyond nuts.
- .10 Types of washers as follows:
  - .1 Plain type washers: use on equipment and sheet metal.
  - .2 Soft gasket lock type washers: use where vibrations occur.
  - .3 Resilient washers: use with stainless steel.
- .11 Deliver, store and maintain packaged material and equipment with manufacturer’s seals and labels intact.
- .12 Prevent damage, adulteration and soiling of products during delivery, handling and storage. Immediately remove rejected products from site.
- .13 Store products in accordance with suppliers’ instructions.
- .14 Touch up damaged factory finished surfaces to Departmental Representative’s satisfaction:
  - .1 Use primer or enamel to match original.
  - .2 Do not paint over nameplates.

### **1.2 Quality of Products**

- .1 Products, materials and equipment (referred to as products) incorporated into work shall be new, not damaged or defective, and of the best quality (compatible with the specifications) for the purpose intended. If requested, furnish evidence as to type, source and quality of the products provided.

- .2 Defective products will be rejected regardless of previous inspections.
  - .1 Inspection does not relieve responsibility, but is precaution against oversight or error.
  - .2 Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .3 Retain purchase orders, invoices and other documents to prove that all products utilized in this Contract meet the requirements of the specifications. Produce documents when requested by the Departmental Representative.
- .4 Should any dispute arise as to quality or fitness of products, the decision rests strictly with the Departmental Representative based upon the requirements of the Contract documents.
- .5 Unless otherwise indicated in the specifications, maintain uniformity of manufacture for any particular or like item throughout the building.
- .6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

### **1.3 Availability of Products**

- .1 Immediately upon signing the Contract, review product delivery requirements and anticipate foreseeable supply delays for any items.
- .2 If delays in supply of products are foreseeable, notify Departmental Representative of such in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of the work.
- .3 In event of failure to notify Departmental Representative at the start of work and should it subsequently appear that the work may be delayed for such reason, the Departmental Representative reserves the right to substitute more readily available products of similar character, at no increase in either the Contract price or the Contract time.

### **1.4 Manufacturer's Instructions**

- .1 Unless otherwise indicated in the specifications, install or erect products in accordance with the manufacturer's instructions.
  - .1 Do not rely on labels or enclosures provided with products.
  - .2 Obtain written instructions directly from the manufacturer.
- .2 Notify Departmental Representative in writing of conflicts between the specifications and the manufacturer's instructions so that the Departmental Representative may establish the course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes the Departmental Representative to require removal and re-installation at no increase in either the Contract price or the Contract time.

### **1.5 Contractor's Options for Selection of Products for Tendering**

- .1 Products are specified by "Prescriptive" specifications: select any product meeting or exceeding specifications.

- .2 Products specified under “Acceptable Products” (used for complex Mechanical or Electrical Systems): select any one of the indicated manufacturers, or any other manufacturer meeting or exceeding the Prescriptive specifications and indicated Products.
- .3 Products specified by performance and referenced standard: select any product meeting or exceeding the referenced standard.
- .4 Products specified to meet particular design requirements or to match existing materials: use only material specified Approved Product. Alternative products may be considered provided full technical data is received in writing by Departmental Representative in accordance with “Special Instructions to Tenderers”.
- .5 When products are specified by a referenced standard or by Performance specifications, upon request of Departmental Representative obtain from manufacturer and independent laboratory report showing that the product meets or exceeds the specified requirements.

#### **1.6 Substitution After Contract Award**

- .1 No substitutions are permitted without prior written approval of the Departmental Representative.
- .2 Proposals for substitution may only be submitted after Contract award. Such request must include statements of respective costs of items originally specified and the proposed substitution.
- .3 Proposals will be considered by the Departmental Representative if:
  - .1 Products selected by tenderer from those specified are not available;
  - .2 Delivery date of products selected from those specified would unduly delay completion of Contract, or
  - .3 Alternative product to that specified, which is brought to the attention of considered by Departmental Representative as equivalent to the product specified, and will result in a credit to the Contract amount.
- .4 Should the proposed substitution be accepted either in part or in whole, assume full responsibility and costs when substitution affects other work on the Project. Pay for design or drawing changes required as result of substitution.
- .5 Amounts of all credits arising from approval of the substitutions will be determined by the Departmental Representative, and the Contract price will be reduced accordingly.

**END OF SECTION**

## **1 GENERAL**

### **1.1 References**

- .1 Equipment manufacturers and model numbers used for design purposes are available for reference only upon request.

### **1.2 Existing Services**

- .1 Before commencing work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.
- .2 Remove abandoned service lines within 2m of structures. Cap or otherwise seal lines at cut-off points as directed by Departmental Representative.

### **1.3 Location of Equipment and Fixtures**

- .1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.
- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
- .3 Inform Departmental Representative of impending installation and obtain approval for actual location.
- .4 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.

### **1.4 Records**

- .1 Maintain a complete, accurate log of control and survey work as it progresses.
- .2 On completion of foundations and major site improvements, prepare a certified survey showing dimensions, locations, angles and elevations of Work.
- .3 Record locations of maintained, re-routed and abandoned service lines.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Action and Informational Submittals**

- .1 Submittals: in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples.
- .2 Submit written request in advance of cutting or alteration which affects:
  - .1 Structural integrity of elements of project.
  - .2 Integrity of weather-exposed or moisture-resistant elements.
  - .3 Efficiency, maintenance, or safety of operational elements.
  - .4 Visual qualities of sight-exposed elements.
  - .5 Work of Owner or separate contractor.
- .3 Include in request:
  - .1 Identification of project.
  - .2 Location and description of affected Work.
  - .3 Statement on necessity for cutting or alteration.
  - .4 Description of proposed Work, and products to be used.
  - .5 Alternatives to cutting and patching.
  - .6 Effect on Work of Owner or separate contractor.
  - .7 Written permission of affected separate contractor.
  - .8 Date and time work will be executed.

### **1.2 Materials**

- .1 Required for original installation.
- .2 Change in Materials: Submit request for substitution in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples.

### **1.3 Preparation**

- .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering, inspect conditions affecting performance of Work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.
- .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
- .5 Provide protection from elements for areas which are to be exposed by uncovering work; maintain excavations free of water.

### **1.4 Execution**

- .1 Execute cutting, fitting, and patching to complete Work.
- .2 Fit several parts together, to integrate with other Work.

- .3 Uncover Work to install ill-timed Work.
- .4 Remove and replace defective and non-conforming Work.
- .5 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
- .6 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .7 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .8 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- .9 Restore work with new products in accordance with requirements of Contract Documents.
- .10 Fit Work to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .11 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material in accordance with Section 07 84 00 – Firestopping, full thickness of the construction element.
- .12 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.
- .13 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

#### **1.5 Waste Management and Disposal**

- .1 Separate waste materials in accordance with Section 01 74 19-Waste Management and Disposal.

**END OF SECTION**



## **1 GENERAL**

### **1.1 References**

- .1 Public Works and Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID:2020, Title: General Conditions - In effect as of April 25, 2013.

### **1.2 Project Cleanliness**

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Owner or other Contractors.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.
- .3 Clear snow and ice from access to building, bank/pile snow in designated areas only.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Provide on-site containers for collection of waste materials and debris.
- .6 Provide and use marked separate bins for recycling. Refer to Section 01 74 19-Waste Management & Disposal.
- .7 Dispose of waste materials and debris off site.
- .8 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .9 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .10 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .11 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .12 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

### **1.3 Final Cleaning**

- .1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .4 Remove waste products and debris other than that caused by Owner or other Contractors.
- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative .Do not burn waste materials on site.

- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, millwork, floors and ceilings.
- .9 Clean lighting reflectors, lenses, and other lighting surfaces.
- .10 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .11 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .12 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .13 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .14 Remove dirt and other disfiguration from exterior surfaces.
- .15 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .16 Sweep and wash clean paved areas.
- .17 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
- .18 Clean roofs, downspouts, and drainage systems.
- .19 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- .20 Remove snow and ice from access to building.

#### **1.4 Waste Management and Disposal**

- .1 Separate waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Related Work**

- .1 Refer to every technical section for waste management and disposal.

### **1.2 Definitions**

- .1 Waste Audit (WA): relates to projected waste generation. Involves controlled separation of waste.
- .2 Waste Reduction Workplan (WRW): a written report which addresses opportunities for reduction, re-use or recycling of materials.
- .3 Materials Source Separation Program (MSSP): consists of a series of ongoing activities to separate re-usable and recyclable waste material into material categories from other types of waste at point of generation.

### **1.3 Materials Source Separation**

- .1 Before project start-up, prepare Materials Source Separation Program. Provide separate containers for re-usable and/or recyclable materials of the following:
  - .1 Gypsum board.
  - .2 Metals.
  - .3 Wood.
  - .4 Plastics
  - .5 Other materials as indicated in technical sections.
- .2 Implement Materials Source Separation Program for waste generated on project in compliance with approved methods and as approved by Departmental Representative.
- .3 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.
- .4 Locate separated materials in areas which minimize material damage.

### **1.4 Diversion of Materials**

- .1 Create a list of materials to be separated from the general waste stream and stockpiled in separate containers, to the approval of the Departmental Representative and consistent with applicable fire regulations.
  - .1 Mark containers.
  - .2 Provide instruction on disposal practices.

### **1.5 Storage, Handling and Application**

- .1 Do work in compliance with Waste Reduction Workplan.
- .2 Handle waste materials not re-used, salvaged, or recycled in accordance with appropriate regulations and codes.
- .3 Materials in separated condition: collect, handle, store on site, and transport off-site to an approved and authorized recycling facility.
- .4 Materials must be immediately separated into required categories for re-use or recycling.
- .5 Unless specified otherwise, materials for removal become the Contractor's property.

- .6 On-site sale of salvaged/recyclable material is not permitted.
- .7 Provide Departmental Representative with receipts indicating quantity of material delivered to landfill.
- .8 Provide Departmental Representative with receipts indicating quantity and type of materials sent for recycling.

**END OF SECTION**

## 1 GENERAL

### 1.1 Administrative Requirements

- .1 Acceptance of Work Procedures:
  - .1 Contractor's Inspection: Contractor and all Sub-Contractors conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
    - .1 Notify Departmental Representative in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.
    - .2 Request Departmental Representative's inspection.
  - .2 Departmental Representative Inspection:
    - .1 Departmental Representative and Contractor to inspect Work and identify defects and deficiencies.
    - .2 Contractor to correct Work as directed.
  - .3 Completion Tasks: submit written certificates in English that tasks have been performed as follows:
    - .1 Work: completed and inspected for compliance with Contract Documents.
    - .2 Defects: corrected and deficiencies completed.
    - .3 Equipment and systems: tested, adjusted, balanced and fully operational.
    - .4 Certificates required by Gas Inspection Branch: submitted.
    - .5 Operation of systems: demonstrated to Owner's personnel.
    - .6 Commissioning and Decommissioning of mechanical systems: completed in accordance with 01 91 31 - Commissioning (Cx) Requirements of final Commissioning Report submitted to Departmental Representative.
    - .7 Work: complete and ready for final inspection.
  - .4 Final Inspection:
    - .1 When completion tasks are done, request final inspection of Work by Departmental Representative and Contractor.
    - .2 When Work incomplete according to Departmental Representative, complete outstanding items and request re-inspection.
  - .5 Declaration of Substantial Performance: when Departmental Representative considers deficiencies and defects corrected and requirements of Contract substantially performed, make application for Certificate of Substantial Performance.
  - .6 Commencement of Lien and Warranty Periods: date of Owner's acceptance of submitted declaration of Substantial Performance to be date for commencement for warranty period and commencement of lien period unless required otherwise by lien statute of Place of Work.
  - .7 Final Payment:

- .1 When Departmental Representative considers final deficiencies and defects corrected and requirements of Contract met, make application for final payment.
- .8 Payment of Holdback: after issuance of Certificate of Substantial Performance of Work, submit application for payment of holdback amount in accordance with contractual agreement.

## **1.2 Final Cleaning**

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Submission**

- .1 Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- .2 Revise content of documents as required before final submittal.
- .3 Ensure spare parts, maintenance materials and special tools provided are new, neither damaged nor defective, and of same quality and manufacture as products provided in work.
- .4 If requested, furnish evidence as to type, source and quality of products provided.
- .5 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.

### **1.2 Format**

- .1 Organize data in the form of an instructional manual.
- .2 Binders: vinyl, hard covered, 3 “D” ring, loose leaf 219x279 mm with spine and face pockets.
- .3 Cover: identify each binder with typed or printed title “Project Record Documents”; list title of project and identify subject matter of contents.
- .4 Arrange content by systems under section numbers and sequence of Table of Contents.
- .5 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .6 Text: manufacturer’s printed data, or typewritten data.
- .7 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

### **1.3 Contents – Each Volume**

- .1 Table of contents – provide the following:
  - .1 Title of project.  
Date of submission.
  - .2 Names, addresses, and telephone numbers of the Departmental Representative and Contractor with name of responsible parties.
  - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system, list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product data: mark each sheet to clearly identify products and component parts, and data applicable to installation. Delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

#### 1.4 As-Built Documents

- .1 **Contract drawings** and shop drawings: legibly mark each item to record actual construction, including:
  - .1 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
  - .2 Field changes of dimension and detail.
  - .3 Changes made by change orders.
  - .4 Details not on original Contract drawings.
  - .5 References to related shop drawings and modifications.
- .2 **Contract Specifications:** legibly mark each item to record actual “Workmanship of Construction”, including:
  - .1 Manufacturer, trade name, and catalogue number of each “Product/Material” actually installed, particularly optional items and substitute items.
  - .2 Changes made by addenda and change orders.
- .3 As-built information:
  - .1 Record changes in red ink.
  - .2 Mark on 1 set of drawings, specifications and shop drawings at completion of project and, before final inspection, neatly transfer notations to second set.
  - .3 Provide 1 set of CDs in AutoCAD file format with all as-built information on the CDs.
  - .4 Submit all sets for the Departmental Representative.

#### 1.5 Equipment and Systems

- .1 Operating procedures – include the following:
  - .1 Start-up, break-in, and routine normal operating instructions and sequences.
  - .2 Regulation, control, stopping, shutdown, and emergency instructions.
  - .3 Summer, winter, and any special operating instructions.
- .2 Provide servicing and lubrication schedule, and list of lubricants required.
- .3 Include manufacturer’s printed operation and maintenance instructions.
- .4 Include sequence of operation by controls manufacturer.
- .5 Provide original manufacturer’s parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .6 Provide installed control diagrams by controls manufacturer.
- .7 Provide Contractor’s coordination drawings with installed colour coded piping diagrams.
- .8 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .9 Provide list of original manufacturer’s spare parts, current prices, and recommended quantities to be maintained in storage.
- .10 Additional requirements: as specified in individual specification Sections.



## **1.6 Manufacturer's Documentation Reports**

- .1 When specified in individual Sections, require manufacturer to provide authorized representative to demonstrate operation of equipment and system, instruct Departmental Representative's indicated facility's personnel, and provide detailed written report that demonstration and instructions have been completed.
- .2 Departmental Representative will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

## **1.7 Spare Parts**

- .1 Provide spare parts in quantities specified in individual specification Sections.
- .2 Provide items of same manufacture and quality as items in work.
- .3 Deliver to on-site location as directed; place and store.
- .4 Receive and catalogue all items. Submit inventory listing to the Departmental Representative. Include approved listings in maintenance manual.
- .5 Obtain receipt for delivered products and submit to Departmental Representative.

## **1.8 Maintenance Materials**

- .1 Provide maintenance and extra materials in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in work.
- .3 Deliver to on-site location as directed; place and store.
- .4 Receive and catalogue all items. Submit inventory listing to the Departmental Representative. Include approved listings in maintenance manual.
- .5 Obtain receipt for delivered products and submit to Departmental Representative.

## **1.9 Special Tools**

- .1 Provide special tools in quantities specified in individual specification Sections.
- .2 Provide items with tags identifying their associated function and equipment.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue all items:
  - .1 Submit inventory listing to the Departmental Representative.
  - .2 Include approved listings in maintenance manual.

## **1.10 Warranties, Bonds, Test Reports, Inspection Reports**

- .1 Separate each Document with index tab sheets keyed to Table of Contents listing.
- .2 List subcontractor, supplier and manufacturer with name, address, and telephone number of responsible principal.
- .3 Obtain Warranties, Bonds, Test Results, Inspection Reports executed in duplicate by subcontractors, suppliers, manufacturers and inspection agencies within 10 days after completion of the applicable item of work.

- .4 Except for items put into use with the Departmental Representative's permission, leave date of beginning of time of warranty until the date of substantial performance is determined.
- .5 Verify that documents are in proper form, contain full information, and are notarized.
- .6 Co-execute submittals when required.
- .7 Retain warranties and bonds until time specified for submittal.

### **1.11 Completion**

- .1 Submit a written certificate that the following have been performed:
  - .1 Work has been completed and inspected for compliance with the Contract documents.
  - .2 Defects have been corrected and deficiencies have been completed.
  - .3 Equipment and systems have been tested, adjusted and balanced and are fully operational.
  - .4 Certificates required by the Boiler Inspection Branch, Fire Commissioner of Canada and utility companies have been submitted.
  - .5 Operation of systems has been demonstrated to the personnel indicated by the Departmental Representative.
  - .6 Work is complete and ready for final inspection.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Administrative Requirements**

- .1 Demonstrate scheduled operation and maintenance of equipment and systems to Owner's personnel two weeks prior to date of substantial performance.
- .2 Owner: provide list of personnel to receive instructions, and co-ordinate their attendance at agreed-upon times.
- .3 Preparation:
  - .1 Verify conditions for demonstration and instructions comply with requirements.
  - .2 Verify designated personnel are present.
  - .3 Ensure equipment has been inspected and put into operation.
  - .4 Ensure testing, adjusting, and balancing has been performed in accordance with Section 01 91 31 - General Commissioning (Cx) Requirements and equipment and systems are fully operational.
- .4 Demonstration and Instructions:
  - .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing and maintenance of each item of equipment at agreed upon times, at the equipment location.
  - .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
  - .3 Review contents of manual in detail to explain aspects of operation and maintenance.
  - .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.

### **1.2 Action and Informational Submittals**

- .1 Provide submittals in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples.
- .2 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Departmental Representative's approval.
- .3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .4 Give time and date of each demonstration, with list of persons present.
- .5 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

### **1.3 Quality Assurance**

- .1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:
  - .1 Instruct Owner's personnel.
  - .2 Provide written report that demonstration and instructions have been completed.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Section Includes**

- .1 Includes general requirements for commissioning facilities and facility systems.
- .2 Refer to sections of Mechanical, Electrical and Communications disciplines.

### **1.2 Definitions**

- .1 Acronyms:
  - .1 Cx – Commissioning.
  - .2 Electric and Electronic Control System for Mechanical Systems.
  - .3 O&M – Operation and Maintenance.
  - .4 PI – Product Information.
  - .5 PV – Performance Verification.
  - .6 TAB – Testing, Adjusting and Balancing.
- .2 Cx – a required program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved.

### **1.3 Quality Assurance**

- .1 Testing organization: current member in good standing of AABC certified to perform specified services.
- .2 Comply with applicable procedures and standards of the certification sponsoring association.
- .3 Perform services under direction of supervisor qualified under certification requirements of sponsoring association.
- .4 Refer to Commissioning (Cx) Plan in Section 01 91 31.

### **1.4 References**

- .1 Associated Air Balance Council (AABC): National Standards for Field Measurement and Instrumentation, Total Systems Balance, Air Distribution-Hydraulics Systems.

### **1.5 Submittals**

- .1 Prior to start of Work, submit name of organization proposed to perform services. Designate who has managerial responsibilities for coordination of entire testing, adjusting and balancing.
- .2 Submit documentation to confirm organization compliance with quality assurance provision.
- .3 Submit 3 preliminary specimen copies of each of report forms proposed for use.
- .4 Ten (10) days prior to Substantial Performance, submit 3 copies of final reports on applicable forms.

- .5 Submit reports of testing, adjusting and balancing postponed due to seasonal, climatic, occupancy, or other reasons beyond Contractor's control, promptly after execution of those services.

#### **1.6 Procedures - General**

- .1 Comply with procedural standards of certifying association under whose standard services will be performed.
- .2 Notify Departmental Representative 3 days prior to beginning of operations.
- .3 Accurately record data for each step.
- .4 Report to Departmental Representative any deficiencies or defects noted during performance of services.

#### **1.7 Contractor's Responsibilities**

- .1 Prepare each system for testing and balancing.
- .2 Cooperate with testing organization and provide access to equipment and systems.
- .3 Provide personnel and operate systems at designated times, and under conditions required for proper testing, adjusting, and balancing.
- .4 Notify testing organization 7 days prior to time project will be ready for testing, adjusting, and balancing.

#### **1.8 Preparation**

- .1 Provide instruments required for testing, adjusting, and balancing operations.
- .2 Make instruments available to Departmental Representative to facilitate spot checks during testing.
- .3 Retain possession of instruments and remove at completion of services.
- .4 Verify systems installation is complete and in continuous operation.
- .5 Verify lighting is turned on when lighting is included in cooling load.
- .6 Verify equipment such as computers, laboratory and electronic equipment are in full operation.

#### **1.9 Final Reports**

- .1 Organization having managerial responsibility shall make reports.
- .2 Ensure each form bears signature of recorder, and that of supervisor of reporting organization.
- .3 Identify each instrument used, and latest date of calibration of each.

#### **1.10 Completion of Commissioning**

- .1 Upon completion of Cx leave systems in normal operating mode.

- .2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.
- .3 Cx deliverables have been submitted and accepted by Departmental Representative.

**END OF SECTION**

## **Part 1 GENERAL**

### **1.1 Summary**

- .1 Section Includes:
  - .1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.
  - .2 Related Requirements
    - .1 Section 01 91 31 Commissioning Plan
    - .2 Section 01 91 33 Commissioning Forms
    - .3 Section 01 91 41 Commissioning Training
  - .3 Acronyms:
    - .1 AFD - Alternate Forms of Delivery, service provider.
    - .2 BMM - Building Management Manual.
    - .3 Cx - Commissioning.
    - .4 EMCS - Energy Monitoring and Control Systems.
    - .5 O M - Operation and Maintenance.
    - .6 PI - Product Information.
    - .7 PV - Performance Verification.
    - .8 TAB - Testing, Adjusting and Balancing.

### **1.2 General**

- .1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
  - .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
  - .2 Ensure appropriate documentation is compiled into the BMM.
  - .3 Effectively train O M staff.
- .2 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
  - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.
  - .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .3 Design Criteria: as per client's requirements or determined by designer. To meet Project functional and operational requirements.



- .4 AFD managed projects the term Departmental Representative in Cx specifications to be interpreted as AFD Service Provider.

### **1.3 Commissioning Overview**

- .1 Section 01 91 31 - Commissioning (Cx) Plan.
- .2 For Cx responsibilities refer to Section 01 91 31 - Commissioning (Cx) Plan.
- .3 Cx to be a line item of Contractor's cost breakdown.
- .4 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .5 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built system is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.
- .6 Departmental Representative will issue Interim Acceptance Certificate when:
  - .1 Completed Cx documentation has been received, reviewed for suitability and approved by Departmental Representative.
  - .2 Equipment, components and systems have been commissioned.
  - .3 O M training has been completed.
- .7 All Cx work is to be completed in accordance with CSA Z320-11 commissioning standards.

### **1.4 Non-Conformance To Performance Verification Requirements**

- .1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the unfunctional system, including related systems as deemed required by Departmental Representative, to ensure effective performance.
- .2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

### **1.5 Pre-Cx Review**

- .1 Before Construction:
  - .1 Review contract documents, confirm by writing to Departmental Representative.
    - .1 Adequacy of provisions for Cx.
    - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
  - .1 Co-ordinate provision, location and installation of provisions for Cx.
- .3 Before start of Cx:
  - .1 Have completed Cx Plan up-to-date.

- .2 Ensure installation of related components, equipment, sub-systems, systems is complete.
  - .3 Fully understand Cx requirements and procedures.
  - .4 Have Cx documentation shelf-ready.
  - .5 Understand completely design criteria and intent and special features.
  - .6 Submit complete start-up documentation to Departmental Representative.
  - .7 Have Cx schedules up-to-date.
  - .8 Ensure systems have been cleaned thoroughly.
  - .9 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and approval.
  - .10 Ensure "As-Built" system schematics are available.
- .4 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

## **1.6 Conflicts**

- .1 Report conflicts between requirements of this section and other sections to Departmental Representative before start-up and obtain clarification.
- .2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

## **1.7 Action And Informational Submittals**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Submit no later than 4 weeks after award of Contract:
    - .1 Name of Contractor's Cx agent.
    - .2 Draft Cx documentation.
    - .3 Preliminary Cx schedule.
  - .2 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.
  - .3 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least 8 weeks prior to start of Cx.
  - .4 Provide additional documentation relating to Cx process required by Departmental Representative.

## **1.8 Commissioning Documentation**

- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use.
- .2 Departmental Representative to review and approve Cx documentation.
- .3 Provide completed and approved Cx documentation to Departmental Representative.

## **1.9 Commissioning Schedule**

- .1 Provide detailed Cx schedule as part of construction schedule

- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
  - .1 Approval of Cx reports.
  - .2 Verification of reported results.
  - .3 Repairs, retesting, re-commissioning, re-verification.
  - .4 Training.

#### **1.10 Commissioning Meetings**

- .1 Convene Cx meetings following project meetings: as specified herein.
- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 60% construction completion stage. Departmental Representative to call a separate Cx scope meeting to review progress, discuss schedule of:
  - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
  - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .6 Meeting will be chaired by Departmental Representative, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

#### **1.11 Starting And Testing**

- .1 Contractor assumes liabilities and costs for inspections. Including disassembly and re-assembly after approval, starting, testing and adjusting, including supply of testing equipment.

#### **1.12 Witnessing Of Starting And Testing**

- .1 Provide 14 days notice prior to commencement.
- .2 Departmental Representative to witness of start-up and testing.
- .3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

#### **1.13 Manufacturer's Involvement**

- .1 Factory testing: manufacturer to:
  - .1 Coordinate time and location of testing.
  - .2 Provide testing documentation for approval by Departmental Representative.
  - .3 Arrange for Departmental Representative to witness tests.

- .4 Obtain written approval of test results and documentation from Departmental Representative before delivery to site.
- .2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Departmental Representative.
  - .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
  - .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .3 Integrity of warranties:
  - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
  - .2 Verify with manufacturer that testing as specified will not void warranties.
- .4 Qualifications of manufacturer's personnel:
  - .1 Experienced in design, installation and operation of equipment and systems.
  - .2 Ability to interpret test results accurately.
  - .3 To report results in clear, concise, logical manner.

#### **1.14 Procedures**

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
  - .1 Included in delivery and installation:
    - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
    - .2 Visual inspection of quality of installation.
  - .2 Start-up: follow accepted start-up procedures.
  - .3 Operational testing: document equipment performance.
  - .4 System PV: include repetition of tests after correcting deficiencies.
  - .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain approval from Departmental Representative after distinct phases have been completed and before commencing next phase.
- .4 Document require tests on approved PV forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Departmental Representative. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
  - .1 Minor equipment/systems: implement corrective measures approved by Departmental Representative.
  - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Departmental Representative.

- .3 If evaluation report concludes that major damage has occurred, Departmental Representative shall reject equipment.
  - .1 Rejected equipment to be remove from site and replace with new.
  - .2 Subject new equipment/systems to specified start-up procedures.

#### **1.15 Start-Up Documentation**

- .1 Assemble start-up documentation and submit to Departmental Representative for approval before commencement of commissioning.
- .2 Start-up documentation to include:
  - .1 Factory and on-site test certificates for specified equipment.
  - .2 Pre-start-up inspection reports.
  - .3 Signed installation/start-up check lists.
  - .4 Start-up reports,
  - .5 Step-by-step description of complete start-up procedures, to permit Departmental Representative to repeat start-up at any time.

#### **1.16 Operation And Maintenance Of Equipment And Systems**

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
- .2 With assistance of manufacturer develop written maintenance program and submit Departmental Representative for approval before implementation.
- .3 Operate and maintain systems for length of time required for commissioning to be completed.
- .4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

#### **1.17 Test Results**

- .1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.
- .2 Provide manpower and materials, assume costs for re-commissioning.

#### **1.18 Start Of Commissioning**

- .1 Notify Departmental Representative at least 21 days prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

#### **1.19 Instruments / Equipment**

- .1 Submit to Departmental Representative for review and approval:
  - .1 Complete list of instruments proposed to be used.
  - .2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.
- .2 Provide the following equipment as required:

- .1 2-way radios.
- .2 Ladders.
- .3 Equipment as required to complete work.

#### **1.20 Commissioning Performance Verification**

- .1 Carry out Cx:
  - .1 Under actual operating conditions, over entire operating range, in all modes.
  - .2 On independent systems and interacting systems.
- .2 Cx procedures to be repeatable and reported results are to be verifiable.
- .3 Follow equipment manufacturer's operating instructions.
- .4 EMCS trending to be available as supporting documentation for performance verification.

#### **1.21 Witnessing Commissioning**

- .1 Departmental Representative to witness activities and verify results.

#### **1.22 Authorities Having Jurisdiction**

- .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.
- .2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.
- .3 Provide copies to Departmental Representative within 5 days of test and with Cx report.

#### **1.23 Extrapolation Of Results**

- .1 Where Cx of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to design conditions when approved by Departmental Representative in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

#### **1.24 Extent Of Verification**

- .1 Provide manpower and instrumentation to verify up to 30 % of reported results, unless specified otherwise in other sections.
- .2 Number and location to be at discretion of Departmental Representative.
- .3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.
- .4 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.
- .5 Perform additional commissioning until results are acceptable to Departmental Representative.

**1.25 Repeat Verifications**

- .1 Assume costs incurred by Departmental Representative for third and subsequent verifications where:
  - .1 Verification of reported results fail to receive Departmental Representative's approval.
  - .2 Repetition of second verification again fails to receive approval.
  - .3 Departmental Representative deems Contractor's request for second verification was premature.

**1.26 Sundry Checks And Adjustments**

- .1 Make adjustments and changes which become apparent as Cx proceeds.
- .2 Perform static and operational checks as applicable and as required.

**1.27 Deficiencies, Faults, Defects**

- .1 Correct deficiencies found during start-up and Cx to satisfaction of Departmental Representative.
- .2 Report problems, faults or defects affecting Cx to Departmental Representative in writing. Stop Cx until problems are rectified. Proceed with written approval from Departmental Representative.

**1.28 Completion Of Commissioning**

- .1 Upon completion of Cx leave systems in normal operating mode.
- .2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.
- .3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by Departmental Representative.

**1.29 Activities Upon Completion Of Commissioning**

- .1 When changes are made to baseline components or system settings established during Cx process, provide updated Cx form for affected item.

**1.30 Training**

- .1 In accordance with Section 01 91 41 - Commissioning (Cx) - Training.

**1.31 Maintenance Materials, Spare Parts, Special Tools**

- .1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in contract.

**1.32 Occupancy**

- .1 Cooperate fully with Departmental Representative during stages of acceptance and occupancy of facility.

**1.33 Installed Instrumentation**

- .1 Use instruments installed under Contract for TAB and PV if:
  - .1 Accuracy complies with these specifications.
  - .2 Calibration certificates have been deposited with Departmental Representative.
- .2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

**1.34 Performance Verification Tolerances**

- .1 Application tolerances:
  - .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 10% of specified values.
- .2 Instrument accuracy tolerances:
  - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement tolerances during verification:
  - .1 Unless otherwise specified actual values to be within +/- 2 % of recorded values.

**1.35 Owner's Performance Testing**

- .1 Performance testing of equipment or system by Departmental Representative will not relieve Contractor from compliance with specified start-up and testing procedures.

**Part 2 PRODUCTS**

**2.1 Not Used**

- .1 Not Used.

**END OF SECTION**



## **1 GENERAL**

### **1.1 Summary**

- .1 This section includes Summary and General Requirements for commissioning the Combined Services Building HVAC rehabilitation at Sandspit Airport. This section is intended to complement the commissioning.
- .2 Related Sections (and Documents):
  - .1 Section 01 11 55 General Instructions
  - .2 Section 01 33 00 Shop Drawings, Product Data & Samples
  - .3 Section 01 78 30 Closeout Submittals
  - .4 Section 01 79 00 Demonstration & Training
  - .5 Section 23 05 48 Vibration and Seismic Controls for HVAC Piping and Equipment
  - .6 Section 23 05 93 Testing, Adjusting & Balancing for HVAC
  - .7 Section 23 08 00 Commissioning of Mechanical Systems
  - .8 Section 23 09 33 Electric and Electronic Control Systems for HVAC
  - .9 Section 23 31 10 Cleaning of Mechanical Duct Systems

### **1.2 General**

- .1 Provide a fully functional facility:
  - .1 Systems, equipment and components meet user's functional requirements before date of acceptance, and operate consistently at peak efficiencies and within specified energy budgets under normal loads.
  - .2 Facility user and O&M personnel have been fully trained in aspects of installed systems.
  - .3 Optimized life cycle costs.
  - .4 Complete documentation relating to installed equipment and systems.
- .2 Term "Cx" in this section means "Commissioning".
- .3 Use this Cx Plan as master planning document for Cx:
  - .1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.
  - .2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.
  - .3 Sets out deliverables relating to O&M, process and administration of Cx.
  - .4 Describes process of verification of how built works meet design requirements.
  - .5 Produces a complete functional system prior to issuance of Certificate of Occupancy.

- .6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
  - .1 Overview of Cx.
  - .2 General description of elements that make up Cx Plan.
  - .3 Process and methodology for successful Cx.
  
- .4 Acronyms:
  - .1 Cx - Commissioning .
  - .2 BMM - Building Management Manual.
  - .3 MSDS - Material Safety Data Sheets.
  - .4 PI - Product Information .
  - .5 PV - Performance Verification .
  - .6 TAB - Testing, Adjusting and Balancing .
  - .7 WHMIS - Workplace Hazardous Materials Information System.
  
- .5 Commissioning terms used in this Section:
  - .1 Bumping: short term start-up to prove ability to start and prove correct rotation .
  - .2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

### **1.3 Refinement of Cx Plan**

- .1 During construction phase, revise, and update Cx Plan to include:
  - .1 Changes resulting from Client program modifications.
  - .2 Approved design and construction changes .
  
- .2 Revise, refine and update every 6 weeks during construction phase. At each revision, indicate revision number and date.
  
- .3 Submit each revised Cx Plan to Departmental Representative for review and obtain written approval.
  
- .4 Include testing parameters at full range of operating conditions and check responses of equipment and systems.

### **1.4 Composition, Roles and Responsibilities of Cx Team**

- .1 Departmental Representative to maintain overall responsibility for project and is sole point of contact between members of commissioning team.
  
- .2 Project Manager will select Cx Team consisting of following members:
  - .1 PWGSC Design Quality Review Team: during construction, will conduct periodic site reviews to observe general progress .

- .2 Commissioning Authority: ensures Cx activities are carried out to ensure delivery of a fully operational project including:
  - .1 Preparation of Commissioning Authority's Plan.
  - .2 Overall coordination of all Cx activities.
  - .3 Protection of health, safety and comfort of occupants and O&M personnel.
  - .4 Monitoring of Cx activities, training, development of Cx documentation .
  - .5 Work closely with members of Cx Team.
  
- .3 Departmental Representative is responsible for overseeing the following:
  - .1 Organizing Cx.
  - .2 Monitoring operations Cx activities.
  - .3 Witnessing and certifying accuracy of reported results .
  - .4 Witnessing and certifying TAB and other tests.
  - .5 Developing BMM.
  - .6 Ensuring implementation of final Cx Plan.
  - .7 Performing verification of performance of installed systems and equipment.
  - .8 Implementation of Training Plan.
  
- .4 Construction Team: contractor, sub-contractors, suppliers and support disciplines, is responsible for construction/installation in accordance with contract documents, including:
  - .1 TAB.
  - .2 Performance of Cx activities .
  - .3 Delivery of training and Cx documentation.
  - .4 Assigning one person as point of contact with the Departmental Representative and PWGSC Cx Manager for administrative and coordination purposes.
  
- .5 The Cx Agent is to be retained and paid for by the Contractor. The Cx Agent is to implement the specified Cx activities including:
  - .1 Demonstrations.
  - .2 Training.
  - .3 Testing.
  - .4 Completion and submission of test reports.
  
- .6 Property Manager: represents lead role in Operation Phase and onwards and is responsible for:
  - .1 Receiving facility.
  - .2 Day-To-Day operation and maintenance of facility.

## 1.5 Cx Participants

- .1 Employ and pay for the services of the following Cx participants to verify performance of equipment and systems:
  - .1 Installation contractor/subcontractor:
    - .1 Equipment and systems installation except as noted.
    - .2 Commissioning tasks related to equipment installation, and verification.
    - .3 Completion of the Product Information (PI), Component Performance Verification (CPV) and System Performance Verification (SPV) forms as noted at the end of this section.
  - .2 Equipment manufacturer: equipment specified to be installed and started by manufacturer.
    - .1 To include performance verification.
  - .3 Client: responsible for intrusion and access security systems.
  - .4 Ensure that Cx participant:
    - .1 Completes the work within scheduled time frame.
    - .2 Is available for emergency and troubleshooting service during first year of occupancy by user for adjustments and modifications outside responsibility of O&M personnel, including:
      - .1 Modify ventilation rates to meet changes in off-gassing.
      - .2 Redistribution of electrical services.
      - .3 Provide names of participants to Departmental Representative and details of instruments and procedures to be followed for Cx 3 months prior to starting date of Cx for review and approval.

## 1.6 Extent of Cx

- .1 HVAC and exhaust systems:
  - .1 HVAC systems: complete and submit commissioning forms.
  - .2 Exhaust systems: complete and submit commissioning forms.
  - .3 Confirm correct operation and scheduling of all motor-driven mechanical components, including but not limited to:
    - .4 All new exhaust fans
    - .5 All new gas furnaces
- .2 Vibration and seismic control measure:
  - .1 Refer to Section 23 05 48 -Vibration & Seismic Controls for Ductwork Piping & Equipment.
  - .2 Submit "Letters of Assurance".

- .3 Ductwork:
  - .1 Related sections:
    - .1 Section 23 31 10-Cleaning of Mechanical Duct Systems.
    - .2 Submit test reports and certificates after completion of work as specified.
  - .4 Commission electrical systems and equipment:
    - .1 Low voltage below 750 V:
      - .1 Low voltage equipment.
      - .2 Low voltage distribution systems.

### **1.7 Deliverables Relating to O&M Perspectives**

- .1 General requirements:
  - .1 Compile English documentation.
  - .2 Documentation to be computer-compatible format ready for inputting for data management.
- .2 Provide deliverables:
  - .1 Warranties.
  - .2 Project record documentation.
  - .3 Inventory of spare parts, special tools and maintenance materials.
  - .4 Maintenance Management System (MMS) identification system used.

### **1.8 Deliverables Relating to the Cx Process**

- .1 General:
  - .1 Start-up, testing and Cx requirements, conditions for acceptance and specifications form part of relevant technical sections of these specifications.
- .2 Definitions:
  - .1 Cx as used in this section includes:
    - .1 Cx of components, equipment, systems, subsystems, and integrated systems.
    - .2 Factory inspections and performance verification tests
- .3 Deliverables: provide:
  - .1 Startup, pre-Cx activities and documentation for systems, and equipment.
  - .2 Completed product information (PI) report forms.
  - .3 Completed component performance verification (CPV) report forms.
  - .4 Results of Performance Verification Tests and Inspections (SPV) report forms
  - .5 Description of Cx activities and documentation.

- .4 Departmental Representative to witness and certify tests and reports of results provided to Departmental Representative.
- .5 Departmental Representative to participate.
- .6 Pre-Cx activities -MECHANICAL:
  - .1 HVAC and exhaust systems:
    - .1 "Bump" each item of equipment in its "stand-alone" mode.
    - .2 Complete pre-start-up checks and complete relevant documentation.
    - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
    - .4 Perform TAB on systems. TAB report to be approved by Departmental Representative.
- .7 Pre-Cx activities -ELECTRICAL:
  - .1 Low voltage distribution systems over 750 V:
  - .2 Requires independent testing agency to perform pre-energization and post-energization tests as applicable.

### **1.9 Commissioning Forms & Related Documentation**

- .1 The Commissioning Agent is responsible for completing all Commissioning Forms. These forms shall be completed for each piece of equipment, in different phases of the project. There are 4 categories:
  - .1 Product Information (PI) Forms
  - .2 Component Performance Verification (CPV) Forms
  - .3 System Performance Verification (SPV) Forms
- .2 Submit completed commissioning forms to the Commissioning Authority and Departmental Representative for review and approval.
- .3 The commissioning Forms indicate the minimal testing requirements developed during the design stage. The Departmental Representative reserves the right to amend the test requirements and procedures during construction at no extra cost to the Owner.
- .4 The Commissioning Agent is responsible for preparing additional commissioning forms not provided in the Commissioning Authority Plan. Submit these forms to Departmental Representative for approval 30 days prior commissioning.
- .5 The Commissioning Agent shall record in the Commissioning Form any installation defects or performance deficiencies encountered during the field checks and tests, and shall be forwarded to the Commissioning Team.

### **1.10 Schedules**

- .1 Prepare detailed critical path Cx Schedule and submit to Departmental Representative for

review and approval same time as project Construction Schedule. Include:

- .1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:
  - .1 Design criteria, design intents.
  - .2 Pre-TAB review: 28 days after contract award, and before construction starts.
  - .3 Cx agents' credentials: 60 days before start of Cx.
  - .4 Cx procedures: 3 months after award of contract.
  - .5 Cx Report format: 3 months after contract award.
  - .6 Discussion of heating/cooling loads for Cx: 3 months before start-up.
- .2 After approval, incorporate Cx Schedule into Construction Schedule.
- .3 Contractor, Contractor's Cx agent, and Departmental Representative will monitor progress of Cx against this schedule.

#### **1.11 Activities During Warranty Period**

- .1 Cx activities must be completed before issuance of Interim Certificate, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:
  - .1 Fine tuning of HVAC systems.

#### **1.12 Addition Mechanical Commissioning Requirements**

- .1 General:
  - .1 The Mechanical Contractor shall designate a Commissioning Agent, who shall be active in the commissioning process and actively encourage his own forces and sub-trades to work together to achieve optimum system performance for the mechanical systems in a timely manner. This individual may be employed by the contractor or be an independent sub-contractor subject to approval by the Departmental Representative.

The Commissioning Agent must have the necessary work experience within similar installations to fulfill the testing and verification procedures. Refer to Commissioning Authority Plan for responsibilities of Commissioning Agent.
  - .2 It is not intended that this work shall, in any way, replace normal factory start-up service for equipment or relieve the Contractor or his sub-trades of their responsibility for providing first-class installation in satisfactory working order.
  - .3 All HVAC systems shall be commissioned, as a minimum, in accordance with:
    - .1 The CSA Z320-11 commissioning standard.
  - .4 As part of the final commissioning report, submit a Certificate stating that the commissioning procedures have been completed, that complete factual reports have

been distributed and that directions have been given to the Contractor to correct faults and omissions and finally, that follow-up testing, after the correction of faults and omissions has been completed and recorded.

.2 Demonstration

- .1 All mechanical systems added, modified, and expanded in this contract.
- .2 Demonstrations shall be video recorded and included in the O&M manual.

.3 Training

- .1 During "Substantial Performance" review, the Mechanical Contractor, Control Sub-contractor, and other Sub-contractors designated by the Departmental Representative shall provide training to the Owner's operating personnel in the proper operation and maintenance of all systems and equipment installed under the contract.
- .2 It shall be the Mechanical Contractor's responsibility to have the specified equipment manuals prepared, previously approved by the Engineer, and ready for presentation to the Owner at this meeting.
- .3 Convene the meeting with the aforementioned parties at the time called for in the substantial performance review. The arrangements shall include written notices to all the parties concerned. Should the equipment manuals, or system installation not be complete and operable at the proper time, he/she shall then convene the operating instruction meeting at a later date and pay any additional costs including time and travelling expenses for the personnel involved which are attributable to the delay.

**1.13 Final Settings**

- .1 Upon completion of Cx to satisfaction of Departmental Representative lock control devices in their final positions, indelibly mark settings marked and include in Cx Reports.

**1.14 Commissioning Forms**

- .1 See following pages 9 through 11.



**Exhaust Fan**

Date: \_\_\_\_\_

Unit #: \_\_\_\_\_

	<b>Specification</b>	<b>Shop Drawing</b>	<b>Installed / Actual</b>
Manufacturer:			
Model:			
HP			
Voltage / phase			
Air Flow Rate (L/S)			
Static Pressure (Pa)			
Location:			
Area Served:			

**Remarks / Comments:**


<b>Representative</b>	<b>Personnel</b>	<b>Verified / Approved</b>
Contractor		
Commissioning Agent		
Commissioning Authority		
Mechanical Consultant		
PWGSC Resource Team		

Commissioning Report  
 Component Performance Verification (CPV) Form  
Exhaust Fans EF-4, EF-5, EF-8, EF-9 RF-1

Page     of  
 Date:\_\_\_\_\_

Unit #:\_\_\_\_\_

	Date yy/mm/dd	Note	OK
Make, model, capacity & accessories as per shop drwgs.			
Unit installation complete.			
Plenums clear and free of loose material.			
Initial drive alignment OK.			
Belt tension adjusted.			
Unit complete & no mfg. defects observed.			
Unit rotates freely.			
Ductwork complete.			
Vibration isolation installed and functional.			
Seismic restraints installed, inspected and functional.			
Backdraft damper operates			
Electrical complete.			
Motor disconnect switch installed.			
Controls complete.			
OK by electrical to start unit.			
Rotation direction correct.			
No unusual sounds/vibration observed.			
Motor operates within nameplate amperage rating.			
Motor overload protection provided.			
Testing & balancing complete.			
Identification complete.			

**Notes:**

<b>1</b>	
<b>2</b>	
<b>3</b>	
<b>4</b>	
<b>5</b>	
<b>6</b>	

Representative	Personnel	Verified / Approved
Contractor		
Commissioning Agent		
Commissioning Authority		
Mechanical Consultant		
PWGSC Resource Team		

END OF SECTION

**Part 1 GENERAL**

**1.1 Summary**

- .1 Section Includes:
  - .1 Commissioning forms to be completed for equipment, system and integrated system.
- .2 Related Sections
  - .1 Section 01 91 13 General Commissioning Requirements.
  - .2 Section 01 91 31 Commissioning plan
  - .3 Section 01 91 41 Commissioning Training

**1.2 Installation/Start-Up Check Lists**

- .1 Include the following data:
  - .1 Product manufacturer's installation instructions and recommended checks.
  - .2 Special procedures as specified in relevant technical sections.
  - .3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.
- .2 Equipment manufacturer's installation/start-up check lists are acceptable for use. As deemed necessary by Departmental Representative supplemental additional data lists will be required for specific project conditions.
- .3 Use check lists for equipment installation. Document check list verifying checks have been made, indicate deficiencies and corrective action taken.
- .4 Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Return completed check lists to Departmental Representative. Check lists will be required during Commissioning and will be included in Building Maintenance Manual (BMM) at completion of project.
- .5 Use of check lists will not be considered part of commissioning process but will be stringently used for equipment pre-start and start-up procedures.

**1.3 Product Information (Pi) Report Forms**

- .1 Product Information (PI) forms compiles gathered data on items of equipment produced by equipment manufacturer, includes nameplate information, parts list, operating instructions, maintenance guidelines and pertinent technical data and recommended checks that is necessary to prepare for start-up and functional testing and used during operation and maintenance of equipment. This documentation is included in the BMM at completion of work.
- .2 Prior to Performance Verification (PV) of systems complete items on PI forms related to systems and obtain Departmental Representative's approval.

#### **1.4 Performance Verification (Pv) Forms**

- .1 PV forms to be used for checks, running dynamic tests and adjustments carried out on equipment and systems to ensure correct operation, efficiently and function independently and interactively with other systems as intended with project requirements.
- .2 PV report forms include those developed by Contractor records measured data and readings taken during functional testing and Performance Verification procedures.
- .3 Prior to PV of integrated system, complete PV forms of related systems and obtain Departmental Representative's approval.

#### **1.5 Samples Of Commissioning Forms**

- .1 Departmental Representative will develop and provide to Contractor required project-specific Commissioning forms in electronic format complete with specification data.
  - .1 Boilers replacement.
  - .2 AHU refurbishment.
- .2 Revise items on Commissioning forms to suit project requirements.
- .3 Samples of Commissioning forms and a complete index of produced to date will be attached to this section.

#### **1.6 Changes and Development Of New Report Forms**

- .1 When additional forms are required, but are not available from Departmental Representative develop appropriate verification forms and submit to Departmental Representative for approval prior to use.
  - .1 Additional commissioning forms to be in same format as provided by Departmental Representative.

#### **1.7 Commissioning Forms**

- .1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.
- .2 Strategy for Use:
  - .1 Departmental Representative provides Contractor project-specific Commissioning forms with Specification data included.
  - .2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
  - .3 Confirm operation as per design criteria and intent.
  - .4 Identify variances between design and operation and reasons for variances.
  - .5 Verify operation in specified normal and emergency modes and under specified load conditions.
  - .6 Record analytical and substantiating data.
  - .7 Verify reported results.
  - .8 Form to bear signatures of recording technician and reviewed and signed off by Departmental Representative.
  - .9 Submit immediately after tests are performed.

- .10 Reported results in true measured SI unit values.
- .11 Provide Departmental Representative with originals of completed forms.
- .12 Maintain copy on site during start-up, testing and commissioning period.

**1.8 Language**

- .1 To suit the language profile of the awarded contract.

**Part 2 PRODUCTS**

**2.1 Not Used**

- .1 Not Used.

**Part 3 EXECUTION**

**3.1 Not Used**

- .1 Not Used.

**END OF SECTION**

Approved: 2005-09-30

## **Part 1 GENERAL**

### **1.1 Summary**

- .1 Section Includes:
  - .1 This Section specifies roles and responsibilities of Commissioning Training.
- .2 Related Requirements
  - .1 Section 01 91 13 General Commissioning Requirements.
  - .2 Section 01 91 31 Commissioning plan
  - .3 Section 01 91 33 Commissioning Forms

### **1.2 Trainees**

- .1 Trainees: personnel selected for operating and maintaining this facility. Includes Facility Manager, building operators, maintenance staff, security staff, and technical specialists as required.
- .2 Trainees will be available for training during later stages of construction for purposes of familiarization with systems.

### **1.3 Instructors**

- .1 Departmental Representative will provide:
  - .1 Descriptions of systems.
- .2 Contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:
  - .1 Start-Up, operation, shut-down of equipment, components and systems.
  - .2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.
  - .3 Instructions on servicing, maintenance and adjustment of systems, equipment and components.
- .3 Contractor and equipment manufacturer to provide instruction on:
  - .1 Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

### **1.4 Training Objectives**

- .1 Training to be detailed and duration to ensure:
  - .1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.
  - .2 Effective on-going inspection, measurements of system performance.
  - .3 Proper preventive maintenance, diagnosis and trouble-shooting.
  - .4 Ability to update documentation.

- .5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

## **1.5 Training Materials**

- .1 Instructors to be responsible for content and quality.
- .2 Training materials to include:
  - .1 "As-Built" Contract Documents.
  - .2 Operating Manual.
  - .3 Maintenance Manual.
  - .4 Management Manual.
  - .5 TAB and PV Reports.
- .3 Project Manager, Commissioning Manager and Facility Manager will review training manuals.
- .4 Training materials to be in a format that permits future training procedures to same degree of detail.
- .5 Supplement training materials:
  - .1 Transparencies for overhead projectors.
  - .2 Multimedia presentations.
  - .3 Manufacturer's training videos.
  - .4 Equipment models.

## **1.6 Scheduling**

- .1 Include in Commissioning Schedule time for training.
- .2 Deliver training during regular working hours.
- .3 Training to be completed prior to acceptance of facility.

## **1.7 Responsibilities**

- .1 Be responsible for:
  - .1 Implementation of training activities,
  - .2 Coordination among instructors,
  - .3 Quality of training, training materials,
- .2 Departmental Representative will evaluate training and materials.
- .3 Upon completion of training, provide written report, signed by Instructors, witnessed by Departmental Representative.

## **1.8 Training Content**

- .1 Training to include demonstrations by Instructors using the installed equipment and systems.
- .2 Content includes:
  - .1 Review of facility and occupancy profile.

- .2 Functional requirements.
  - .3 System philosophy, limitations of systems and emergency procedures.
  - .4 Review of system layout, equipment, components and controls.
  - .5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
  - .6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.
  - .7 Maintenance and servicing.
  - .8 Trouble-shooting diagnosis.
  - .9 Inter-Action among systems during integrated operation.
  - .10 Review of O M documentation.
- .3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

**1.9 Video-Based Training**

- .1 Manufacturer's videotapes may be used as training tool with Departmental Representative's review and written approval 3 months prior to commencement of scheduled training.
- .2 On-Site training videos:
  - .1 Videotape training sessions for use during future training.
  - .2 To be performed after systems are fully commissioned.
  - .3 Organize into several short modules to permit incorporation of changes.
- .3 Production methods to be high quality.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**



## **1 GENERAL**

### **1.1 References**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-51.33-[M89], Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.
  - .2 CAN/CGSB-51.34-[M86], Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.

### **1.2 Action and Informational Submittals**

- .1 Provide submittals in accordance with Section 01 33 00 – Shop Drawings, Product Data & Samples.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet and include:
    - .1 Product characteristics.
    - .2 Performance criteria.
    - .3 Limitations.
  - .3 Quality assurance submittals:
    - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
    - .2 Instructions: submit manufacturer's installation instructions and comply with written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **1.3 Quality Assurance**

- .1 Mock-Ups:
  - .1 Construct mock-up of sheet vapour barrier installation including one lap joint, one inside corner and at one electrical box. Mock-up may be part of finished work.
  - .2 Mock-up will be used to judge workmanship, substrate preparation, and material application.
  - .3 Locate where directed.
  - .4 Allow 24 hours for inspection of mock-up by Departmental Representative before proceeding with vapour barrier work.
- .2 When accepted, mock-up will demonstrate minimum standard of quality required for this work.

### **1.4 Delivery, Storage and Handling**

- .1 Waste Management and Disposal:

- .2 Separate waste materials in accordance with Section 01 74 19 - Waste Management & Disposal.

## **2 PRODUCTS**

### **2.1 Sheet Vapour Barrier**

- .1 Polyethylene film: to CAN/CGSB-51.34, 0.15 mm thick.
- .2 Foil: to CAN/CGSB-51.33, Type 1, bright aluminum 95% reflective, laminated with flame resistant adhesive to one side of flame resistant kraft paper, ULC labelled.

### **2.2 Accessories**

- .1 Joint sealing tape: air resistant pressure sensitive adhesive tape, type recommended by vapour barrier manufacturer, 50 mm wide for lap joints and perimeter seals, 25 mm wide elsewhere.
- .2 Sealant: compatible with vapour retarder materials, recommended by vapour retarder manufacturer.
- .3 Staples: minimum 6 mm leg.
- .4 Molded box vapour barrier: factory-molded polyethylene box for use with recessed electric switch and outlet device boxes.

## **3 EXECUTION**

### **3.1 Installation**

- .1 Ensure services are installed and inspected prior to installation of retarder.
- .2 Install sheet vapour retarder on warm side of exterior wall, ceiling, and floor assemblies prior to installation of gypsum board to form continuous retarder.
- .3 Use sheets of largest practical size to minimize joints.
- .4 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.

### **3.2 Exterior Surfaces Openings**

- .1 Cut sheet vapour retarder to form openings and ensure material is lapped and sealed to frame.

### **3.3 Perimeter Seals**

- .1 Seal perimeter of sheet vapour barrier as follows:
  - .1 Apply continuous bead of sealant to substrate at perimeter of sheets.
  - .2 Lap sheet over sealant and press into sealant bead.
  - .3 Install staples through lapped sheets at sealant bead into wood substrate.
  - .4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

### **3.4 Lap Joint Seals**

- .1 Seal lap joints of sheet vapour barrier as follows:
  - .1 Attach first sheet to substrate.
  - .2 Apply continuous bead of sealant over solid backing at joint.
  - .3 Lap adjoining sheet minimum 150 mm and press into sealant bead.
  - .4 Install staples through lapped sheets at sealant bead into wood substrate.
  - .5 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

### **3.5 Electrical Boxes**

- .1 Seal electrical switch and outlet device boxes that penetrate vapour barrier as follows:
  - .1 Wrap boxes with film sheet providing minimum 300 mm perimeter lap flange.
  - .2 Apply sealant to seal edges of flange to main vapour barrier and seal wiring penetrations through box cover.

### **3.6 Cleaning**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

## 1 GENERAL

### 1.1 References

- .1 The Aluminum Association Inc. (AAI)
  - .1 AAI-Aluminum Sheet Metal Work in Building Construction-2002.
  - .2 AAI DAF45-03, Designation System for Aluminum Finishes.
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A 167-99(2004), Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
  - .2 ASTM A 240/A 240M-07e1, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - .3 ASTM A 606-04, Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.
  - .4 ASTM A 653/A 653M-07, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .5 ASTM A 792/A 792M-06a, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
  - .6 ASTM B 32-04, Standard Specification for Solder Metal.
  - .7 ASTM B 370-03, Standard Specification for Copper Sheet and Strip for Building Construction.
  - .8 ASTM D 523-89(1999), Standard Test Method for Specular Gloss.
  - .9 ASTM D 822-01(2006), Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
- .3 Canadian Roofing Contractors Association (CRCA)
  - .1 Roofing Specifications Manual 1997.
- .4 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.
  - .2 CAN/CGSB-93.1-M85, Sheet Aluminum Alloy, Prefinished, Residential.
- .5 Canadian Standards Association (CSA International)
  - .1 CSA A123.3-05, Asphalt Saturated Organic Roofing Felt.
  - .2 AAMA/WDMA/CSA 101/I.S.2/A440-2008, Standard/Specification for Windows, Doors, and Unit Skylights.
  - .3 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
- .6 Green Seal Environmental Standards
  - .1 Standard GS-03-93, Anti-Corrosive Paints.
  - .2 Standard GS-11-97, Architectural Paints.
  - .3 Standard GS-36-00, Commercial Adhesives.

- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

## **1.2 Action and Informational Submittals**

- .1 Provide submittals in accordance with Section 01 33 00 – Shop Drawings, Product Data & Samples.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature for sheet metal flashing systems materials, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 33 - Health and Safety Requirements 01 35 43 - Environmental Procedures.
- .3 Shop Drawings:
  - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia, Canada.
- .4 Samples:
  - .1 Submit duplicate 50 x 50 mm samples of each type of sheet metal material, finishes and colours.
- .5 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
  - .1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.
  - .2 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3, FIELD QUALITY CONTROL.

## **1.3 Quality Assurance**

- .1 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with contractor's representative and Departmental Representative to:
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Co-ordination with other building sub-trades.
  - .4 Review manufacturer's installation instructions and warranty requirements.

## **1.4 Delivery, Storage and Handling**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

## **2 PRODUCTS**

### **2.1 Sheet Metal Materials**

- .1 Copper sheet: to ASTM B 370 temper designation.
- .2 Zinc coated steel sheet: commercial quality to ASTM A 653/A 653M, with Z275 designation zinc coating.
- .3 Aluminum-zinc alloy coated steel sheet: to ASTM A 792/A 792M, commercial quality.
- .4 Electrolytic zinc coated, chromate treated, steel sheet: to ASTM A 591/A 591M, commercial quality.
- .5 Weathering steel sheet: to ASTM A 606 high strength low alloy cold rolled architectural use grade, 1.2 mm minimum thickness.
- .6 Aluminum sheet: proprietary utility sheet plain pattern.

### **2.2 Prefinished Steel Sheet**

- .1 Prefinished steel with factory applied polyvinylidene fluoride.
  - .1 Class F1S.
  - .2 Colour selected by Departmental Representative from manufacturer's standard range.
  - .3 Specular gloss: 30 units +/- in accordance with ASTM D 523.
  - .4 Coating thickness: not less than 22 micrometres.
  - .5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20 % to ASTM D 822 as follows:
    - .1 Outdoor exposure period 2500 hours.
    - .2 Humidity resistance exposure period 5000 hours.
- .2 Prefinished steel with factory applied polyvinyl chloride.
  - .1 Class F1S.
  - .2 Colour selected by Departmental Representative from manufacturer's standard range.
  - .3 Specular gloss: 30 units +/- 5 in accordance with ASTM D 523.
  - .4 Coating thickness: not less than 200 micrometres.
  - .5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20 % to ASTM D 822 as follows:
    - .1 Outdoor exposure period 5000 hours.
    - .2 Humidity resistance exposure period 5000 hours.

- .3 Prefinished steel with factory applied silicone modified polyester.
  - .1 Class F1S.
  - .2 Colour selected by Departmental Representative.
  - .3 Specular gloss: 30 units +/- 5 in accordance with ASTM D 523.
  - .4 Coating thickness: not less than 20 micrometres.
  - .5 Resistance to accelerated weathering for chalk rating of 8 colour fade 5 units or less and erosion rate less than 20% to ASTM D 822 as follows:
    - .1 Outdoor exposure period 500 hours.
    - .2 Humidity resistance exposure period 500 hours.

### **2.3 Prefinished Aluminum Sheet**

- .1 Finish: factory applied coating to CAN/CGSB-93.1 supplemented and amended as follows:
  - .1 Type 1.
  - .2 Class F1S.
  - .3 Colour selected by Departmental Representative from manufacturer's standard range.
- .2 Thickness specified for prefinished aluminum sheet applies to base metal.

### **2.4 Accessories**

- .1 Isolation coating: alkali resistant bituminous paint.
- .2 Plastic cement: to CAN/CGSB 37.5.
- .3 Underlay for metal flashing: dry sheathing to CAN/CGSB-51.32 asphalt laminated 3.6 to 4.5 kg kraft paper No. 15 perforated asphalt felt to CSA A123.3.
- .4 Sealants:
  - .1 Maximum VOC limit 50 g/L.
- .5 Cleats: of same material, and temper as sheet metal, minimum 50mm wide. Thickness same as sheet metal being secured.
- .6 Fasteners: of same material as sheet metal, to CSA B111, ring thread flat head roofing nails of length and thickness suitable for metal flashing application.
- .7 Washers: of same material as sheet metal, 1 mm thick with rubber packings.
- .8 Solder: to ASTM B 32.
- .9 Flux: rosin, cut hydrochloric acid, or commercial preparation suitable for materials to be soldered.
- .10 Touch-up paint: as recommended by prefinished material manufacturer.
  - .1 Maximum VOC limit 50 g/L to Standard GS-11.

## **2.5 Fabrication**

- .1 Fabricate metal flashings and other sheet metal work as indicated.
- .2 Fabricate aluminum flashings and other sheet aluminum work in accordance with AAI-Aluminum Sheet Metal Work in Building Construction.
- .3 Form pieces in 2400 mm maximum lengths.
  - .1 Make allowance for expansion at joints.
- .4 Hem exposed edges on underside 12 mm.
  - .1 Mitre and seal corners with sealant.
- .5 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .6 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

## **2.6 Metal Flashings**

- .1 Form flashings, copings and fascias to profiles indicated of galvanized prefinished.

## **2.7 Reglets and Cap Flashings**

- .1 Form metal cap flashing of sheet metal for base flashings.
  - .1 Provide slotted fixing holes and steel/plastic washer fasteners.
  - .2 Cover face and ends with plastic tape.

## **2.8 Aluminum Finishes**

- .1 Finish exposed surfaces of aluminum components in accordance with AAI DAF45.
- .2 Appearance and properties of anodized finishes designated by Aluminum Association as Architectural Class 1, Architectural Class 2, and Protective and Decorative: to AAMA/WDMA/CSA-101/I.S.2/A440, for coating Classes 1, 2 and 3 respectively.

## **3 EXECUTION**

### **3.1 Manufacturer's Instructions**

- .1 Compliance: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

### **3.2 Installation**

- .1 Install sheet metal work in accordance with CRCA FL series details AAI-Aluminum Sheet Metal Work in Building Construction.



- .2 Use concealed fastenings except where approved before installation.
- .3 Provide underlay under sheet metal.
  - .1 Secure in place and lap joints 100 mm.
- .4 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.
  - .1 Flash joints using standing seams forming tight fit over hook strips.
- .5 Lock end joints and caulk with sealant.
- .6 Install surface mounted reglets true and level, and caulk top of reglet with sealant.
- .7 Insert metal flashing under cap flashing to form weather tight junction.
- .8 Turn top edge of flashing into recessed reglet or mortar joint minimum of 25 mm. Lead wedge flashing securely into joint.
- .9 Caulk flashing at cap flashing with sealant.
- .10 Install pans, where shown around items projecting through roof membrane.

### **3.3 Scuppers**

- .1 Install scuppers as indicated.

### **3.4 Field Quality Control**

- .1 Manufacturer's Field Services:
  - .1 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

### **3.5 Cleaning**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Leave work areas clean, free from grease, finger marks and stains.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Related Requirements**

- .1 Section 23 05 00 Common Work Results-Mechanical
- .2 Section 26 05 00 Common Work Results-Electrical

### **1.2 References**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 Underwriter's Laboratories of Canada (ULC)
  - .1 ULC-S115-1995, Fire Tests of Fire stop Systems.

### **1.3 Definitions**

- .1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.
- .2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.
- .3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.
- .4 Tightly Fitted; (ref: NBC Part 3.1.9.1.1 and 9.10.9.6.1): penetrating items that are cast in place in buildings of noncombustible construction or have "0" annular space in buildings of combustible construction.
  - .1 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

### **1.4 Action and Informational Submittals**

- .1 Provide submittals in accordance with Section 01 33 00 – Shop Drawings, Product Data & Samples.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit shop drawings to show location, proposed material, reinforcement, anchorage, fastenings and method of installation.

- .2 Construction details should accurately reflect actual job conditions.
- .4 Samples:
  - .1 Submit duplicate 300 x 300 mm samples showing actual fire stop material proposed for project.
- .5 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
  - .1 Test reports: in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.
    - .1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.
  - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.
  - .4 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in 01 33 00 – Shop Drawings, Product Data and Samples.

## **1.5 Quality Assurance**

- .1 Qualifications:
  - .1 Installer: company person specializing in fire stopping installations with 5 years documented experience approved by manufacturer.
- .2 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work:
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Co-ordination with other building sub-trades.
  - .4 Review manufacturer's installation instructions and warranty requirements.

## **1.6 Delivery, Storage and Handling**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - .3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name manufacturer, ULC markings.
- .2 Storage and Protection:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Replace defective or damaged materials with new.

- .3 Waste Management and Disposal:
  - .1 Separate waste materials in accordance with Section 01 74 19 - Waste Management & Disposal.

## **2 PRODUCTS**

### **2.1 Materials**

- .1 Fire stopping and smoke seal systems: in accordance with CAN-ULC-S115.
  - .1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN- ULC-S115 and not to exceed opening sizes for which they are intended
  - .2 Fire stop system rating: as noted.
- .2 Service penetration assemblies: systems tested to CAN-ULC-S115.
- .3 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115.
- .4 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.
- .5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.
- .6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.
- .7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .8 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
- .9 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
- .10 Sealants for vertical joints: non-sagging.

## **3 EXECUTION**

### **3.1 Manufacturer's Instructions**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

### **3.2 Preparation**

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.

- .1 Ensure that substrates and surfaces are clean, dry and frost free.
- .2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
- .3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.
- .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

### **3.3 Installation**

- .1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.
- .2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .4 Tool or trowel exposed surfaces to neat finish.
- .5 Remove excess compound promptly as work progresses and upon completion.

### **3.4 Sequences of Operation**

- .1 Proceed with installation only when submittals have been reviewed by Manufacturer's Representative and Department Representative.
- .2 Install floor fire stopping before interior partition erections.
- .3 Metal deck bonding: fire stopping to precede spray applied fireproofing to ensure required bonding.
- .4 Mechanical pipe insulation: certified fire stop system component.
  - .1 Ensure pipe insulation installation precedes fire stopping.

### **3.5 Field Quality Control**

- .1 Inspections: notify Departmental Representative when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports
  - .2 Provide Manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with

- Manufacturer's instructions.
- .3 Schedule site visits, to review Work.

### **3.6 Cleaning**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Remove temporary dams after initial set of fire stopping and smoke seal materials.

### **3.7 Schedule**

- .1 Fire stop and smoke seal at:
  - .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
  - .2 Edge of floor slabs at curtain wall and precast concrete panels.
  - .3 Top of fire-resistance rated masonry and gypsum board partitions.
  - .4 Intersection of fire-resistance rated masonry and gypsum board partitions.
  - .5 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
  - .6 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.
  - .7 Openings and sleeves installed for future use through fire separations.
  - .8 Around mechanical and electrical assemblies penetrating fire separations.
  - .9 Rigid ducts: greater than 129 cm<sup>2</sup>: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Related Sections**

- .1 Read Division 1 General Requirements in conjunction with these specifications. Division 1 and this section shall form a part of and shall apply to all Mechanical Sections. The most stringent requirements of this and other Mechanical Sections must be adhered to.
- .2 The Mechanical work shall consist of the supply and installation of complete and operable mechanical systems and shall include all necessary labour, plant, materials, and incidentals for the work involved as listed in the following division sections:
  - .1 Section 22 Plumbing
  - .2 Section 23 Heating, Ventilation & Air Conditioning

### **1.2 Submittals**

- .1 Submittals: in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples.
- .2 Shop drawings to show:
  - .1 Mounting arrangements.
  - .2 Operating and maintenance clearances.
- .3 Shop drawings and product data accompanied by:
  - .1 Detailed drawings of bases, supports, and anchor bolts.
  - .2 Acoustical sound power data, where applicable.
  - .3 Points of operation on performance curves.
  - .4 Manufacturer to certify current model production.
  - .5 Certification of compliance to applicable codes.
- .4 In addition to transmittal letter referred to in Section 01 33 00 - Shop Drawings, Product Data & Samples: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .5 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 30 - Closeout Submittals.
  - .2 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
  - .3 Operation data to include:
    - .1 Control schematics for systems including environmental controls.
    - .2 Description of systems and their controls.
    - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
    - .4 Operation instruction for systems and component.
    - .5 Description of actions to be taken in event of equipment failure.

- .6 Valves schedule and flow diagram.
- .7 Colour coding chart.
- .4 Maintenance data to include:
  - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
  - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .5 Performance data to include:
  - .1 Equipment performance verification test results.
  - .2 Special performance data as specified.
- .6 Approvals:
  - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
  - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .7 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
  - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
  - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection.
- .9 As-built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit to Departmental Representative for approval and make corrections as directed.



- .4 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

### **1.3 Regulations**

- .1 Comply with most stringent requirements of NBC, Provincial and Municipal regulations and by-laws, specified standards, codes and this specification. Practices contained in these standards or standards suggested or recommended by reference organizations, are to be taken as minimum requirements.
- .2 Furnish certificates confirming work installed conforms to requirements of authorities having jurisdiction.
- .3 Drawings and specifications should not conflict with these Regulations but where there are apparent discrepancies, notify the Departmental Representative in writing and obtain clarifications before proceeding with the work.

### **1.4 Quality Assurance**

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.

### **1.5 Definitions**

- .1 Definitions used in this Division will have the following meaning:
  - .1 "Concealed": pipes, ducts, etc., in trenches, chases, furred spaces, pipe shafts, or hung ceilings.
  - .2 "Exposed": regarding insulation and painting of piping, ducts, etc., will mean that they are not "concealed", as defined herein.
  - .3 "Piping": includes, in addition to pipe, all fittings, valves, hangers, other accessories which comprise a system.
  - .4 "Provide": to supply and install, complete and ready for use.

### **1.6 Drawings**

- .1 Drawings:
  - .1 Are not intended to show structural details or architectural features.
  - .2 Are not to be scaled.
  - .3 Except where dimensioned, indicate general mechanical layouts only.
- .2 Provide field (shop) drawings to indicate relative position of various services when required by Departmental Representative and obtain approval before commencing work.

### **1.7 Maintenance**

- .1 Furnish spare parts in accordance with Section 01 78 30 - Closeout Submittals as indicated in the detailed product specification clauses.
- .2 Provide access doors for concealed expansion joints, traps, strainers, cleanouts, balance dampers, fire dampers, other parts requiring accessibility for operating and maintenance.
- .3 In suspended panel ceilings, use panel in place of access door; provide in such panel a button or other means of identification and easy removal when necessary.

## **1.8 Delivery, Storage and Handling**

- .1 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management & Disposal.

## **2 PRODUCTS**

### **2.1 Access Doors**

- .1 Access door size shall be as indicated and where not indicated, make 305mm x 406mm [12" x 16"] minimum or 610mm x 457mm [24" x 18"] where persons have to enter. For acoustical ceilings, conform to architectural panel pattern.
- .2 Unless otherwise indicated, access doors shall be hinged, flush type, steel framed panel, 14 gauge minimum, satin finished galvanized steel or type 304 stainless steel, with anchor straps for wet areas, washrooms, and all walls finished in ceramic tile.
- .3 Hinges shall be concealed, spring hinge to allow door to open 175°. Locking devices shall be flush cam type, screwdriver operated, doors and frames shall have prime coated rust inhibiting paint, unless made of stainless steel.
- .4 Where doors are required in fire rated walls, access doors shall be uninsulated and for all fire rated ceilings and walls where maximum temperature rise limitation is applicable, shall be insulated. All fire rated access doors shall have Warnock Hersey or ULC listed 2 hour fire rating and shall be installed in accordance with NFPA 80 and manufacturer's installation instructions.

## **3 EXECUTION**

### **3.1 Co-ordination**

- .1 Co-ordinate work with work of other sections to avoid conflict.
- .2 Locate distribution systems, equipment, and materials to provide minimum interferences and maximum usable space.
- .3 Where interference occurs, Departmental Representative shall approve relocation of equipment and materials, regardless of installation sequence.

### **3.2 Cleaning**

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

### **3.3 Cutting and Patching**

- .1 Make arrangements with General Contractor for all cutting and patching in this work.
- .2 Minimize cutting and patching. Set sleeves and mark openings in concrete or masonry.

### **3.4 Waterproofing**

- .1 Where any work pierces waterproofing including waterproofing concrete, the method of installation shall be as approved by the Departmental Representative before the work is done. Supply and install all necessary sleeves, caulking, roof curbs, and flashing required and make the openings watertight.

### **3.5 Protection of Work**

- .1 Protect equipment and material during construction from the weather, moisture, dust, painting, plastering and physical damage. Clean and return to "as new" condition.
- .2 Mask or grease and cover machined surfaces. Firmly secure covers over equipment openings and open ends of piping, conduit and ductwork as work progresses. Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.
- .3 Any equipment that has operating parts, bearings or machined surfaces that show signs of rusting, pitting or physical damage will be rejected.
- .4 Refinish damaged or marred factory finishes to the satisfaction of the Departmental Representative, using equal quality materials.

### **3.6 Field Quality Control**

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in 01 33 00 – Shop Drawings, Product Data & Samples.
- .2 Manufacturer's Field Services:
  - .1 Where specified, obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in 01 33 00 – Shop Drawings, Product Data & Samples.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, as directed in 01 11 55 – General Instructions.

### **3.7 Demonstration**

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual and as-built drawings as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Use of Systems**

- .1 Use of new permanent heating and ventilating systems for supplying temporary heat or ventilation is permitted only under the following conditions:
  - .1 Entire system is complete, pressure tested, cleaned, flushed out.
  - .2 Specified water treatment system has been commissioned, water treatment is being continuously monitored.
  - .3 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
  - .4 There is no possibility of damage from any cause.
  - .5 Supply ventilation systems are protected by filters, which shall be inspected daily, changed every week or more frequently as required.
  - .6 Return systems have approved filters over all openings, inlets, outlets.
  - .7 All systems will be:
    - .1 operated as per manufacturer's recommendations or instructions.
    - .2 operated by Contractor.
  - .3 monitored continuously by Contractor.
  - .8 Warranties and guarantees are not thereby relaxed.
  - .9 Regular preventive and all other manufacturers recommended maintenance routines are performed by Contractor at his own expense and under supervision of Departmental Representative.
  - .10 Before static completion, entire system to be refurbished, cleaned internally and externally, restored to "as- new" condition, filters in air systems replaced.
- .2 Filters referred to herein are over and above those specified elsewhere in this specification.
- .3 Exhaust systems are not included in any approvals for temporary heating ventilation.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Related Sections**

- .1 Section 01 74 19 Waste Management & Disposal
- .2 Section 23 05 00 Common Work Results – Mechanical

### **1.2 References**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.181-1999, Ready-Mixed Organic Zinc-Rich Coating.

### **1.3 Waste Management and Disposal**

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management & Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.

## **2 PRODUCTS**

### **2.1 Not Used**

- .1 Not Used

## **3. EXECUTION**

### **3.1 Connections to Equipment**

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

### **3.2 Clearances**

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, or components.

### 3.3 Pipework Installation

- .1 Protect openings against entry of foreign material.
- .2 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .3 Assemble piping using fittings manufactured to ANSI standards.
- .4 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .5 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .6 Valves:
  - .1 Install in accessible locations.
  - .2 Remove interior parts before soldering.
  - .3 Install with stems above horizontal position unless otherwise indicated.
  - .4 Valves accessible for maintenance without removing adjacent piping.
  - .5 Install globe valves in bypass around control valves.
  - .6 Use chain operators on valves NPS 2-1/2 and larger where installed more than 2400mm above floor in Mechanical Rooms.
- .7 Install dielectric coupling between dissimilar metals.

### 3.4 Sleeves

- .1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.
- .2 Material: Schedule 40 black steel pipe.
- .3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.
- .4 Sizes: 6 mm minimum clearance between sleeve and un-insulated pipe or between sleeve and insulation.
- .5 Installation:
  - .1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.
  - .2 Other floors: Terminate 25mm above finished floor.
- .6 Sealing:
  - .1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.
  - .2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.
  - .3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.
  - .4 Ensure no contact between copper pipe or tube and sleeve.

### **3.5 Escutcheons**

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: One piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.
- .3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe.

### **3.6 Pressure Testing of Equipment and Pipework**

- .1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: Test as specified in relevant sections.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.
- .6 Conceal work only after approval and certification of tests by Departmental Representative.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Related Sections**

- |    |                  |                                       |
|----|------------------|---------------------------------------|
| .1 | Section 01 33 00 | Shop Drawings, Product Data & Samples |
| .2 | Section 01 74 19 | Waste Management & Disposal           |
| .3 | Section 23 05 00 | Common Work Results – Mechanical      |
| .4 | Section 23 34 00 | HVAC Fans                             |

### **1.2 References**

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1 ASHRAE 90.1-2001, Energy Code for Buildings Except Low-Rise Residential Buildings.
- .2 Electrical Equipment Manufacturers' Advisory Council (EEMAC)
- .3 Workplace Hazardous Material Information System (WHMIS)

### **1.3 Section Includes**

- .1 Electrical work to conform to Division 26 including the following:
  - .1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
  - .2 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 23. Refer to Division 26 for quality of materials and workmanship.

### **1.4 Shop Drawings**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples.

### **1.5 Closeout Submittals**

- .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 33 00 - Shop Drawings, Product Data & Samples.

### **1.6 Waste Management and Disposal**

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management & Disposal.
- .2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .3 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .4 Dispose of packaging material in appropriate on-site bin for recycling in accordance with site waste management program.



## **2 PRODUCTS**

### **2.1 General**

- .1 Motors to be high efficiency, in accordance with local Hydro company standards and the requirements of ASHRAE 90.1.

### **2.2 Motors**

- .1 Provide motors for mechanical equipment as specified.
- .2 Motors under 373 W 1/2 HP : speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120V, unless otherwise specified or indicated.
- .3 Motors 373 W 1/2 HP and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C, 3 phase, 208V, unless otherwise specified or indicated.

### **2.3 Belt Drives**

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.
- .3 For motors under 7.5 kW 10HP : standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kW 10HP and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Correct size of sheave to be determined during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Motor slide rail adjustment plates to allow for centre line adjustment.

### **2.4 Drive Guards**

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives:
  - .1 Expanded metal screen welded to steel frame.
  - .2 Minimum 1.2mm thick sheet metal tops and bottoms.
  - .3 38mm dia. holes on both shaft centres for insertion of tachometer.
  - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.
- .5 Guard for flexible coupling:
  - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
  - .2 Securely fasten in place.

- .3 Removable for servicing.
- .6 Unprotected fan inlets or outlets:
  - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
  - .2 Net free area of guard: not less than 80% of fan openings.
  - .3 Securely fasten in place.
  - .4 Removable for servicing.

### **3 EXECUTION**

#### **3.1 Installation**

- .1 Fasten securely in place.
- .2 Make removable for servicing, easily returned into, and positively in position.

**END OF SECTION**

## 1 GENERAL

### 1.1 Related Section

.1	Section 01 33 00	Shop Drawings, Product Data & Samples
.2	Section 01 35 33	Health & Safety Requirements
.3	Section 01 61 00	Common Product Requirements
.4	Section 01 74 19	Waste Management & Disposal
.5	Section 01 78 30	Closeout Submittals
.6	Section 23 05 00	Common Work Results – Mechanical
.7	Section 23 05 48	Vibration & Seismic Control for Ductwork, Piping and Equipment

### 1.2 References

- .1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
  - .1 Seismic Restraint Manual, Guidelines for Mechanical Systems, 1998.
- .2 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME):
  - .1 ANSI/ASME B31.1-01, Power Piping, (SI Edition).
- .3 American Society for Testing and Materials (ASTM):
  - .1 ASTM A 125-1996, Specification for Steel Springs, Helical, Heat-Treated.
  - .2 ASTM A 307-00, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
  - .3 ASTM A 563-00, Specification for Carbon and Alloy Steel Nuts.
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):
  - .1 MSS SP58-1993, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2 MSS SP69-1996, Pipe Hangers and Supports - Selection and Application.
  - .3 MSS SP89-1998, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 National Plumbing Code.

### 1.3 System Description

- .1 Design Requirements:
  - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
  - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.

- .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
- .4 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP58.
- .2 Performance Requirements:
  - .1 Design supports and hangers to withstand seismic events as specified Section 23 05 48 – Vibration & Seismic Control for Ductwork, Piping and Equipment.

#### **1.4 Submittals**

- .1 Submittals: in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples.
- .2 Submit shop drawings and product data for following items:
  - .1 Bases, hangers and supports.
  - .2 Connections to equipment and structure.
  - .3 Structural assemblies.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
- .4 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 30 - Closeout Submittals.

#### **1.5 Quality Assurance**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.

#### **1.6 Delivery, Storage and Handling**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Section 01 61 10 - Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:

- .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management & Disposal.

## **2 PRODUCTS**

### **2.1 General**

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

### **2.2 Pipe Hangers**

- .1 Finishes:
  - .1 Pipe hangers and supports: galvanized after manufacture.
  - .2 Use electro-plating galvanizing process.
  - .3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 Upper attachment to concrete.
  - .1 Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye [6] mm minimum greater than rod diameter.
  - .2 Concrete inserts: wedge shaped body with knockout protector plate to MSS SP69.
- .3 Hanger rods: threaded rod material to MSS SP58.
  - .1 Ensure that hanger rods are subject to tensile loading only.
  - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
- .4 Pipe attachments: material to MSS SP58.
  - .1 Attachments for steel piping: carbon steel galvanized.
  - .2 Attachments for copper piping: copper plated black steel.
  - .3 Use insulation shields for hot pipework.
  - .4 Oversize pipe hangers and supports.
- .5 Hanger rod attachment: material to MSS SP58.
  - .1 Use expansion anchor on existing concrete structure.
- .6 Adjustable clevis: material to MSS SP 69, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
  - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.

### 3 EXECUTION

#### 3.1 Installation

- .1 Install in accordance with:
  - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
  - .1 Install on piping systems per Section 23 05 48 – Vibration and Seismic Controls for HVAC Ductwork, Piping and Equipment.
- .3 Clevis plates:
  - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations. Supporting piping from underside of light weight roof deck (without concrete) is not permitted.

#### 3.2 Hanger Spacing

- .1 HVAC piping: in accordance with table below.
- .2 Plumbing piping: in accordance with the most stringent requirements of the table below as well as the following:
  - .1 National. Plumbing Code.
  - .2 Authority Having Jurisdiction.
- .3 Pipe hanger rods shall be sized in accordance to SMACNA Seismic Restraint Manual based on Seismic Hazard Level (SHL). For SHL, see Section 23 05 48 – Vibration and Seismic Controls for HVAC Ductwork, Piping and Equipment.

<b>MAXIMUM HANGER SPACING</b>						
PIPE DIA. NPS	STEEL SCH.40	COPPER L,K Hard Drawn	CAST.I STD.	GLASS	ABS/PVC	PEX
1/2	1.8 m [6'-0"]	1.8 m [6'-0"]			1.2 m [4'-0"]	0.8 m [2'-6"]
3/4 & 1	2.4 m [8'-0"]	2.4 m [8'-0"]			1.2 m [4'-0"]	0.8 m [2'-6"]
1-1/4	2.4 m [8'-0"]	3.0 m [10'-0"]			1.2 m [4'-0"]	0.8 m [2'-6"]
1-1/2 & 2	2.4 m [8'-0"]	3.0 m [10'-0"]	3.0 m [10'-0"]		1.2 m [4'-0"]	0.8 m [2'-6"]
2-1/2, 3, 4 & 5	2.4 m [8'-0"]	3.0 m [10'-0"]	3.0 m [10'-0"]	2.4 m [8'-0"]	1.2 m [4'-0"]	0.8 m [2'-6"]
6 & 8	3.0 m [10'-0"]	3.0 m [10'-0"]	3.0 m [10'-0"]	2.4 m [8'-0"]	1.2 m [4'-0"]	0.8 m [2'-6"]

#### 3.3 Hanger Installation

- .1 Install hanger so that rod is vertical under operating conditions.

- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

### **3.4 Horizontal Movement**

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

### **3.5 Final Adjustment**

- .1 Adjust hangers and supports:
  - .1 Ensure that rod is vertical under operating conditions.
  - .2 Equalize loads.
- .2 Adjustable clevis:
  - .1 Tighten hanger load nut securely to ensure proper hanger performance.
  - .2 Tighten upper nut after adjustment.

**END OF SECTION**



## **1 GENERAL**

### **1.1 Related Sections**

- .1 Section 01 33 00 Shop Drawings, Product Data & Samples
- .2 Section 01 74 19 Waste Management & Disposal
- .3 Section 23 05 00 Common Work Results – Mechanical

### **1.2 References**

- .1 National Building Code of Canada (NBC)
- .2 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
  - .1 Seismic Restraint Manual, Guidelines for Mechanical Systems, 1998.

### **1.3 Shop Drawings**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples.
- .2 Provide vibration isolation systems shop drawings complete with performance and product data. Shop drawings shall demonstrate compliance with the National Building Code and shall bear the seal of a Professional Engineer.
- .3 Provide detailed drawings of all seismic restraint systems for ductwork, piping and equipment. This is to include the existing AHU equipment and boiler units.

### **1.4 Waste Management and Disposal**

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management & Disposal.
- .2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .3 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .4 Dispose of packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

## **2 PRODUCTS**

### **2.1 Vibration Isolation System – General**

- .1 Performance of vibration isolation systems shall be designed by manufacturer specializing in vibration isolation materials and devices.
- .2 Size and shape of bases type shall be coordinated with submitted equipment.
- .3 Products shall of the same manufacturer unless otherwise noted.

### **2.2 Elastomeric Pads**

- .1 Type EP1 - neoprene waffle or ribbed; 9 mm [3/8"] minimum thick; 50 durometer; maximum loading 350 kPa [50 psi].

- .2 Type EP2 - rubber waffle or ribbed; 9 mm [3/8"] minimum thick; 30 durometer natural rubber; maximum loading 415 kPa [60 psi].
- .3 Type EP3 - neoprene-steel-neoprene; 9 mm [3/8"] minimum thick neoprene bonded to 1.71 mm [16 gauge] steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa [50 psi].
- .4 Type EP4 - rubber-steel-rubber; 9 mm [3/8"] minimum thick rubber bonded to 1.71 mm [16 gauge] steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa [60 psi].

### **2.3 Hangers**

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact.
- .2 Type H1 - neoprene - in-shear, molded with rod isolation bushing which passes through hanger box.
- .3 Type H2 - stable spring, elastomeric washer, cup with molded isolation bushing which passes through hanger box.
- .4 Type H3 - stable spring, elastomeric element, cup with molded isolation bushing which passes through hanger box.
- .5 Type H4 - stable spring, elastomeric element with pre-compression washer and nut with deflection indicator.

### **2.4 Acoustic Barriers for Anchors and Guides**

- .1 Acoustic barriers: between pipe and support, consisting of 25 mm [1"] minimum thick heavy duty duck and neoprene isolation material.

### **2.5 Flexible Pipe Connectors**

- .1 Inner corrugated hose: stainless steel.
- .2 Outer braid: Braided wire mesh stainless steel outer jacket.
- .3 End connection: threaded for 50mm [2"] or smaller; flange for 65mm [2-1/2"] or larger.
- .4 Operating conditions:
  - .1 Working pressure: 1379 kPa [200 psi].
  - .2 Working temperature: 4540 °C [850 °F].

### **2.6 Seismic Control Measures**

- .1 General:
  - .1 Design anchorage and attachment methods for all systems and/or equipment as specified herein.
  - .2 Seismic control systems to work in all directions.
  - .3 Fasteners and attachment points to resist same maximum load as seismic restraint.
  - .4 Drilled or power driven anchors and fasteners not permitted.
  - .5 No equipment, equipment supports or mounts to fail before failure of structure.

- .6 Supports of cast iron or threaded pipe not permitted.
- .7 Seismic control measures not to interfere with integrity of firestopping.
- .8 For equipment mounted on housekeeping pad, specify the minimum distance between anchor bolt and edge of housekeeping pad.
- .2 Static equipment:
  - .1 Anchor equipment to equipment supports. Anchor equipment supports to structure.
  - .2 Seismic restraints:
    - .1 Cushioning action to be gentle and steady.
    - .2 Shall never reach metal-like stiffness.
- .3 Vibration isolated equipment:
  - .1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9mm clearance during normal operation of equipment and systems between seismic restraint and equipment.
  - .2 Provide seismic restraints in addition to vibration isolation system to resist complete isolator unloading.
- .4 Piping systems:
  - .1 Provide seismic restraints for all piping in accordance to the latest edition of SMACNA Seismic Restraint Manual as described below:
    - .1 All compressed air piping NPS 1 or larger.
  - .2 Seismic restraints may be omitted for the following conditions:
    - .1 All piping suspended by individual hangers 305mm [12"] or less in length, as measured from the top of the pipe to the bottom of the structural support for the hanger.
  - .3 To be compatible with requirements for anchoring and guiding of piping systems.
  - .4 Wet weight of piping shall be to be used for designing seismic restraint systems.
  - .5 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not reverse.
  - .6 Where cable is used for restraining vibration isolated piping systems, install cable with sufficient slack to avoid short-circuiting of vibration isolators.
- .5 Ductwork systems:
  - .1 Provide seismic restraints for all ductwork in accordance to the latest edition of SMACNA Seismic Restraint Manual as described below:
    - .1 All rectangular ducts with cross sectional areas  $0.56\text{m}^2$  [6 ft<sup>2</sup>] and larger.
    - .2 All round ducts with diameters 711 mm [28"] and larger.
  - .2 Seismic restraints may be omitted for the following conditions:
    - .1 All ductwork suspended by hangers 305mm [12"] or less in length, as measured from the top of the duct to the bottom of the structural support for the hanger.

- .6 Bracing methods:
  - .1 Approved by Departmental Representative.
  - .2 Structural angles or channels.
  - .3 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

### **3 EXECUTION**

#### **3.1 Manufacturer's Instructions**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

#### **3.2 Installation**

- .1 Seismic control measures to meet requirements of NBC.
- .2 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.
- .3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .4 Where isolation is bolted to floor use vibration isolation rubber washers.
- .5 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

#### **3.3 Field Quality Control**

- .1 Provide the services of the Professional Engineer(s) who designed the restraint systems for "Field Review" of the installed components, and submit the following to the Departmental Representative:
  - .1 Assurance commitment letter, signed and sealed; provided at the commencement of the project.
  - .2 Signed and sealed shop drawings of seismic restraints for equipment, piping and ductwork; provided prior to installation.
  - .3 Typewritten inspection reports; provided during the construction period.
  - .4 Schedule C-B, signed and sealed; provided after performing "Field Review". This is to include the existing AHU equipment and boiler units.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Related Sections**

- |    |                  |                                       |
|----|------------------|---------------------------------------|
| .1 | Section 01 33 00 | Shop Drawings, Product Data & Samples |
| .2 | Section 01 35 33 | Health & Safety Requirements          |
| .3 | Section 01 61 00 | Common Product Requirements           |
| .4 | Section 01 61 10 | Product Requirements                  |
| .5 | Section 01 74 19 | Waste Management & Disposal           |
| .6 | Section 23 05 00 | Common Work Results – Mechanical      |

### **1.2 References**

- .1 Canadian Gas Association (CGA)
  - .1 CSA/CGA B149.1, Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
  - .2 CAN/CGSB-24.3, Identification of Piping Systems.
- .3 National Fire Protection Association (NFPA)
  - .1 NFPA 13, Standard for the Installation of Sprinkler Systems.
  - .2 NFPA 14, Standard for the Installation of Standpipe and Hose Systems.

### **1.3 Submittals**

- .1 Product Data:
- .2 Submittals: in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
  - .1 Submit samples in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples.
  - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

### **1.4 Quality Assurance**

- .1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.

### **1.5 Delivery, Storage, and Handling**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Section 01 61 10 - Product Requirements.

- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management & Disposal.
  - .2 Dispose of unused paint and coating material at official hazardous material collections site approved by Departmental Representative.
  - .3 Do not dispose of unused paint and coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

## 2 PRODUCTS

### 2.1 Manufacturer's Equipment Nameplates

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
  - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
  - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

### 2.2 System Nameplates

- .1 Colours:
  - .1 Hazardous: red letters, white background.
  - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
  - .1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
  - .1 Conform to following table:

	<u>Sizes (mm)</u>	<u>No. of Lines</u>	<u>Height of Letters (mm)</u>
1	10 x 50	1	3
2	13 x 75	1	5
3	11 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12

8	25 x 125	2	8
9	35 x 200	1	20

- .2 Use maximum of 25 letters/numbers per line.
- .4 Identification for PWGSC Preventive Maintenance Support System (PMSS):
  - .1 Use arrangement of Main identifier, Source identifier, Destination identifier.
  - .2 Equipment in Mechanical Room:
    - .1 Main identifier: Size #9.
    - .2 Source and Destination identifiers: Size #6.
    - .3 Terminal cabinets, control panels: Size #5.
  - .3 Equipment elsewhere: Sizes as appropriate.

### 2.3 Piping Systems Governed by Codes

- .1 Identification:
  - .1 Natural gas and propane: to CSA/CGA B149.1.
  - .2 Sprinklers: to NFPA 13.

### 2.4 Identification of Piping Systems

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Pictograms:
  - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
  - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 Arrows showing direction of flow:
  - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
  - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
  - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
  - .1 To full circumference of pipe or insulation.
  - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
  - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
  - .2 Other pipes: pressure vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

.7 Colours and Legends:

- .1 Where not listed, obtain direction from Departmental Representative.
- .2 Colours for legends, arrows: to following table:

**Background Colour: Legend, Arrows:**

Yellow	BLACK
Green	WHITE
Red	WHITE

- .3 Background colour marking and legends for piping systems:

CONTENTS	BACKGROUND COLOUR MARKING	LEGEND
Hot water heating supply	Yellow	HWS
Hot water heating return	Yellow	HWR
Domestic hot water supply	Green	DHWS
Domestic HW recirculation	Green	DHWR
Domestic cold water supply	Green	DCWS
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN.VENT
Natural gas and propane	to Codes	G

**2.5 Identification Ductwork Systems**

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

**2.6 Valves, Controllers**

- .1 Plastic tags with 12 mm stamped identification data.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

**2.7 Controls Components Identification**

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.

**2.8 Language**

- .1 Identification in English.



### **3 EXECUTION**

#### **3.1 Manufacturer's Instructions**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

#### **3.2 Timing**

- .1 Provide identification only after painting has been completed.

#### **3.3 Installation**

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide CSA registration plates as required by respective agency.
- .3 Identify systems, equipment to conform to PWGSC PMSS.

#### **3.4 Nameplates**

- .1 Locations:
  - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
  - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:
  - .1 Do not paint, insulate or cover.

#### **3.5 Location of Identification on Piping and Ductwork Systems**

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
  - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

**3.6 Valves, Controllers**

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

**3.7 Cleaning**

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

## **1 GENERAL**

### **1.1 General**

- .1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

### **1.2 Qualifications of TAB Company**

- .1 Testing and balancing shall be performed by an agency that specializes in this type of work. Provide proof that the agency has successfully completed five projects of similar size and scope
- .2 All work shall be performed by persons with proven ability and thoroughly versed in the type of testing and balancing. Submit names, complete with experience, record and references for review by the Departmental Representative prior to work being carried out.

### **1.3 Purpose of TAB**

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2 Adjust and regulate installed equipment and systems so as to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and installed equipment to regulate flow rates to match load requirements over full operating ranges.

### **1.4 Exceptions**

- .1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of authority having jurisdiction.
- .2 TAB of existing equipment already in operation.

### **1.5 Co-Ordination**

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

### **1.6 Pre-TAB Review**

- .1 Review contract documents before project construction is started.
- .2 Review specified standards and report to Departmental Representative in writing all proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

### **1.7 Start-Up**

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

- .2 Follow special start-up procedures specified elsewhere in Division 23.

### **1.8 Operation of Systems During TAB**

- .1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.

### **1.9 Start of TAB**

- .1 Notify Departmental Representative 7 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
  - .1 Installation of ceilings, doors, windows, other construction affecting TAB.
  - .2 Application of weather-stripping, sealing, caulking.
  - .3 All pressure, leakage, other tests specified elsewhere Division 23.
  - .4 All provisions for TAB installed and operational.
- .3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
  - .1 Proper thermal overload protection in place for electrical equipment.
  - .2 Air systems:
    - .1 Filters in place, clean.
    - .2 Duct systems clean.
    - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
    - .4 Correct fan rotation.
    - .5 Fire, smoke, volume control dampers installed and open.
    - .6 Access doors, installed, closed.
    - .7 Outlets installed, volume control dampers open.

### **1.10 Application Tolerances**

- .1 Do TAB to following tolerances of design values:
  - .1 HVAC systems: plus 5%, minus 5%.
  - .2 Hydronic systems: plus or minus 10%.

### **1.11 Accuracy Tolerances**

- .1 Measured values to be accurate to within plus or minus 2% of actual values.

### **1.12 Instruments**

- .1 Prior to TAB, submit to Departmental Representative list of instruments to be used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

### **1.13 Submittals**

- .1 Submit, prior to commencement of TAB:
- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.

#### **1.14 Preliminary TAB Report**

- .1 Submit for checking and approval of Departmental Representative prior to submission of formal TAB report, sample of rough TAB sheets. Include:
  - .1 Details of instruments used.
  - .2 Details of TAB procedures employed.
  - .3 Calculations procedures.
  - .4 Summaries.

#### **1.15 TAB Report**

- .1 Format to be in accordance with Associated Air Balance Council Manual.
- .2 TAB report to show results in SI units and to include:
  - .1 Project record drawings.
  - .2 System schematics.
- .3 Submit 6 copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

#### **1.16 Verification**

- .1 Reported results subject to verification by Departmental Representative.
- .2 Provide manpower and instrumentation to verify up to 30% of reported results.
- .3 Number and location of verified results to be at discretion of Departmental Representative.
- .4 Bear costs to repeat TAB as required to satisfaction of Departmental Representative.

#### **1.17 Settings**

- .1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

#### **1.18 Completion of TAB**

- .1 TAB to be considered complete when final TAB Report received and approved by Departmental Representative.

#### **1.19 Air Systems**

- .1 Standard: TAB to be to most stringent of this section or TAB standards of ASHRAE.
- .2 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop, temperatures (dry bulb, wet bulb, dew point, duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

- .3 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
  - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
  - .2 At controllers, controlled device.
- .4 Locations of systems measurements to include, but not be limited to, following as appropriate: Main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

#### **1.20 Other TAB Requirements**

- .1 Air terminal units:
  - .1 Check individually for correct operation and factory calibration of air volumes at "maximum" and "minimum" settings. Where calibration or adjustment is found to be necessary it shall be carried out as part of the balancing procedure. The mechanical contractor and the Departmental Representative shall be informed of the extent of recalibration required.
- .2 Testing of Fire Dampers & Fire Stop Flaps:
  - .1 Conduct a "trip" test on all fire dampers and fire stop flaps to ensure that fire mechanisms function correctly and that dampers attain a fully closed position when tripped.
  - .2 Send a copy of test results tabulating the fire damper location, size, and date of trip test, to the Departmental Representative for record purposes. Copies shall also be inserted in Equipment Maintenance Manuals.
  - .3 Dampers and Flaps which fail to function correctly shall be re-tested after corrective action has been completed. Any fusible links damaged when conducting tests shall be replaced by this Contractor. A signed and dated test label shall be attached to each fire damper upon completion of test and resetting of fire damper.

#### **1.21 CAD Drawings**

- .1 CAD drawing files of the heating and ventilating tender drawings will be made available to the Balancing Contractor if requested. To cover administrative time and the cost of retrieval and transmission of files, a charge of \$25.00 will be made for each drawing requested, to an upset maximum of \$150 per project. An "Authorization to use CAD Drawing File" agreement restricting the use of the CAD files to the preparation of the project balancing reports must be signed prior to obtaining the files.

**END OF SECTION**

## 1 GENERAL

### 1.1 Related Sections

.1	Section 01 33 00	Shop Drawings, Product Data & Samples
.2	Section 01 35 33	Health & Safety Requirements
.3	Section 01 61 00	Common Product Requirements
.4	Section 01 61 10	Product Requirements
.5	Section 01 74 11	Cleaning
.6	Section 01 74 19	Waste Management & Disposal
.7	Section 23 05 00	Common Work Results - Mechanical
.8	Section 23 05 29	Hangers and Supports for HVAC Piping and Equipment

### 1.2 References

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1 ANSI/ASHRAE/IESNA 90.1-2004; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 American Society for Testing and Materials International, (ASTM)
  - .1 ASTM B 209M-2002, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
  - .2 ASTM C 335-1995, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3 ASTM C 411-1997, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .4 ASTM C 449/C 449M-2000, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5 ASTM C 547-2000, Specification for Mineral Fiber Pipe Insulation.
  - .6 ASTM C 553-2000, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .7 ASTM C 612-2000a, Specification for Mineral Fiber Block and Board Thermal Insulation.
  - .8 ASTM C 795-1992, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
  - .9 ASTM C 921-[92(1998)e1], Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .3 Canadian General Standards Board (CGSB)
  - .1 CGSB 51-GP-52Ma-1989, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).

- .5 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-M88(R2000), Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701-2001, Thermal Insulation Polyotrene, Boards and Pipe Covering.
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

### **1.3 Definitions**

- .1 For purposes of this section:
  - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED"-will mean "not concealed" as defined herein.
- .2 TIAC Codes:
  - .1 CRD: Code Round Ductwork,
  - .2 CRF: Code Rectangular Finish.

### **1.4 Submittals**

- .1 Submittals: in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples.
- .3 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples.
- .4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.

### **1.5 Quality Assurance**

- .1 Qualifications:
  - .1 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.



- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.

## **1.6 Delivery, Storage and Handling**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 10 - Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
  - .1 Protect from weather, construction traffic.
  - .2 Protect against damage.
  - .3 Store at temperatures and conditions required by manufacturer.
- .3 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management & Disposal.
  - .2 Place excess or unused insulation and insulation accessory materials in designated containers.
  - .3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
  - .4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

## **2 PRODUCTS**

### **2.1 Fire and Smoke Rating**

- .1 In accordance with CAN/ULC-S102:
  - .1 Maximum flame spread rating: 25.
  - .2 Maximum smoke developed rating: 50.

### **2.2 Insulation**

- .1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C 335.
- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C 612. Provide factory applied vapour retarder jacket to CGSB 51-GP-52Ma as scheduled in PART 3 of this Section.

- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C 553. Provide factory applied vapour retarder jacket to CGSB 51-GP-52Ma as scheduled in PART 3 of this section.
  - .1 Mineral fibre: to ASTM C 553.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to ASTM C 553.
- .5 Evidence shall be provided to the Departmental Representative on the site of ULC listings of all products being used. Duct insulation adhesives and coatings shall be non-toxic as defined by WCB Regulations.

### **2.3 Jackets**

- .1 Canvas:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
  - .2 Lagging adhesive: Compatible with insulation.
- .2 Aluminum foil laminate:
  - .1 Multi-layer aluminum foil laminate; highly puncture and resistant, non-permeable vapour barrier for complete moisture protection. Inhibits mold growth. UL listed.
  - .2 Total thickness: 0.20 mm.
  - .3 Substrate thickness: 0.15 mm sheet.
  - .4 Finish: Aluminum, stucco embossed.
  - .5 Adhesive: cold weather acrylic adhesive.

### **2.4 Accessories**

- .1 Vapour retarder lap adhesive:
  - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C 449.
- .4 Outdoor Vapour Retarder Mastic:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
  - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m<sup>2</sup>.
- .5 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .6 Contact adhesive: quick-setting
- .7 Facing: 25 mm stainless steel hexagonal wire mesh stitched on one face of insulation.
- .8 Fasteners: 2 mm diameter pins with 35 mm square clips, length to suit thickness of insulation.

### 3 EXECUTION

#### 3.1 Manufacturer's Instructions

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

#### 3.2 Pre-Installation Requirement

- .1 Pressure testing of ductwork systems complete, witnessed and certified.
- .2 Surfaces clean, dry and free from foreign material.

#### 3.3 Installation

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and as indicated.
- .3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Hangers, supports to be outside vapour retarder jacket.
- .5 Supports, Hangers in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
  - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.
- .7 All ductwork exposed to weather shall have waterproof seams for weathertight construction. Exposed, ducts which are not insulated or finish painted, shall be coated with two applications of bitumastic waterproofing compound to prevent corrosion.

#### 3.4 Duct Insulation Schedules

- .1 Insulation types and thicknesses: Conform to following table:

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular, cold, dual temperature supply air ducts	C-1	Yes	50
Round, cold, dual temperature supply air ducts	C-2	Yes	50
Rectangular, warm air ducts	C-1	No	25
Round, warm air ducts	C-2	No	25
Supply, return and exhaust ducts exposed in space being served			None
Outside air ducts to mixing plenum	C-1	Yes	25
Exhaust ducts between dampers and louvers	C-1	No	25
Rectangular ducts outside	C-1	Special	50
Round ducts outside	C-2	Special	50
Acoustically lined ducts			None

- .2 Finish: Conform to following table:

	TIAC Code	
	Rectangular	Round
Indoor, concealed	None	None
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5

### 3.5 Cleaning

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 Related Sections**

- |    |                  |  |
|----|------------------|--|
| .1 | Section 01 11 55 | General Instructions                               |
| .2 | Section 01 35 33 | Health and Safety Requirements                     |
| .3 | Section 23 05 00 | Common Work Results - Mechanical                   |
| .4 | Section 23 05 05 | Installation of Pipe Work.                         |
| .5 | Section 23 05 29 | Hangers and Supports for HVAC Piping and Equipment |

### **1.2 References**

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1 ANSI/ASHRAE/IESNA 90.1-2013; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 American Society for Testing and Materials International, (ASTM)
  - .1 ASTM B209M-10, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
  - .2 ASTM C335/C335M-10e1, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3 ASTM C411-11, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .4 ASTM C449-07(2013), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5 ASTM C547-12, Standard Specification for Mineral Fiber Pipe Insulation.
  - .6 ASTM C553-13, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .7 ASTM C612-14, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
  - .8 ASTM C795-08(2013), Standard Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
  - .9 ASTM C921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
  - .1 CGSB 51-GP-52Ma-1989, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Thermal Insulation Association of Canada (TIAC):
  - .1 Mechanical Insulation Best Practice Guide, 2013.
- .5 South Coast Air Quality Management District (SCAQMD), California State
  - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

- .6 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-07, Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701-11, Standard for Thermal Insulation Polyotrene, Boards and Pipe Covering.
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

### **1.3 Definitions**

- .1 For purposes of this section:
  - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED"-will mean "not concealed" as defined herein.
- .2 TIAC Codes:
  - .1 CRF: Code Rectangular Finish.
  - .2 CPF: Code Piping Finish.

### **1.4 Submittals**

- .1 Submittals: in accordance with Section 01 11 55 – General Instructions.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 – General Instructions. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 01 50 – General Instructions.
- .3 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 11 55 – General Instructions.
- .4 Quality assurance submittals: submit following in accordance with Section 01 11 55 – General Instructions.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.

### **1.5 Quality Assurance**

- .1 Qualifications:
  - .1 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

## **1.6 Delivery, Storage and Handling**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 11 55 – General Instructions.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
  - .1 Protect from weather, construction traffic.
  - .2 Protect against damage.
  - .3 Store at temperatures and conditions required by manufacturer.
- .3 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 11 55 – General Instructions.
  - .2 Place excess or unused insulation and insulation accessory materials in designated containers.
  - .3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
  - .4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

## **PART 2 - PRODUCTS**

### **2.1 Fire and Smoke Rating**

- .1 In accordance with CAN/ULC-S102:
  - .1 Maximum flame spread rating: 25.
  - .2 Maximum smoke developed rating: 50.

### **2.2 Insulation**

- .1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.

- .3 TIAC Code A-1: Rigid molded mineral fibre without factory applied vapour retarder jacket.
  - .1 Mineral fibre: to CAN/CGSB-51.9 / ASTM C547.
  - .2 Maximum "k" factor: to CAN/CGSB-51.9.
- .4 TIAC Code A-2: Rigid molded calcium silicate without factory applied vapour retarder jacket.
  - .1 Calcium silicate: to CAN/CGSB-51.2 / ASTM C533.
  - .2 Maximum "k" factor: to CAN/CGSB-51.2.
- .5 TIAC Code A-3: Rigid molded mineral fibre with factory applied vapour retarder jacket.
  - .1 Mineral fibre: to CAN/CGSB-51.9 / ASTM C547.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to CAN/CGSB-51.9 / ASTM C547.
- .6 TIAC Code C-2: Mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
  - .1 Mineral fibre: to CAN/ULC-S702 / ASTM C553.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to CAN/ULC-S702 / ASTM C553.
- .6 TIAC Code A-6: Flexible unicellular tubular elastomer.
  - .1 Insulation: flexible closed-cell elastomer to ASTM C534.
  - .2 Jacket: to CGSB 51-GP-52Ma. Required for outdoor application.
  - .3 Maximum "k" factor: 0.27.
  - .4 Vapour transmission: 0.08 perm-inch.
  - .5 To be certified by manufacturer to be free of potential stress corrosion cracking corrodants.
- .7 To be formaldehyde free, low VOC; resists mold and mildew.
- .8 Evidence shall be provided to the Engineer on the site of ULC listings of all products being used. Duct insulation adhesives and coatings shall be non-toxic as defined by WCB Regulations.

### **2.3 Insulation Securement**

- .1 Tape: Self-adhesive, aluminum, reinforced, 50mm wide minimum.
- .2 Contact adhesive: Quick setting.
  - .1 Maximum VOC limit 80 g/L to SCAQMD Rule 1168.
- .3 Canvas adhesive: Washable.
  - .1 Maximum VOC limit 250 g/L to SCAQMD Rule 1168.
- .4 Tie wire: 1.5mm diameter stainless steel.
- .5 Bands: Stainless steel, 19mm wide, 0.5mm thick.



## 2.4 Cement

- .1 Thermal insulating and finishing cement:
  - .1 To CAN/CGSB-51.12.
  - .2 Hydraulic setting or Air drying on mineral wool, to ASTM C 449.

## 2.5 Vapour Retarder Lap Adhesive

- .1 Water based, fire retardant type, compatible with insulation.

## 2.6 Indoor Vapour Retarder Finish

- .1 Vinyl emulsion type acrylic, compatible with insulation.

## 2.7 Outdoor Vapour Retarder Finish

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m.

## 2.8 Jackets

- .1 Polyvinyl Chloride (PVC):
  - .1 One-piece molded- type and sheet to CGSB 51-GP-53M with pre-formed shapes as required.
  - .2 Colours: White.
  - .3 Minimum service temperatures: 20°C [68°F].
  - .4 Maximum service temperature: 65°C [150°F].
  - .5 Moisture vapour transmission: 0.02 perm.
  - .6 Fastenings:
    - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
    - .2 Tacks.
    - .3 Pressure sensitive vinyl tape of matching colour.
- .2 Canvas:
  - .1 220 and 120 gm/m cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
  - .2 Lagging adhesive: Compatible with insulation.
    - .1 Maximum VOC limit 250 g/L to SCAQMD Rule 1168.
- .3 Aluminum:
  - .1 To ASTM B 209 with and without moisture barrier as scheduled in PART 3 of this section.
  - .2 Thickness: 0.50 mm sheet.
  - .3 Finish: Stucco embossed.
  - .4 Jacket banding and mechanical seals: 19 mm wide, 0.5 mm thick stainless steel.

## **PART 3 - EXECUTION**

### **3.1 Pre-Installation Requirement**

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2 Surfaces to be clean, dry and free from foreign material.

### **3.2 Installation**

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Hangers, supports to be outside vapour retarder jacket.
- .5 Supports, hangers:
  - .1 Apply high compressive strength insulation, suitable for service, at oversized pipe supports, saddles and shoes. See Section 23 05 29 – Hangers and Supports for Piping and Equipment.
- .6 Seal vapor barrier penetrations with vapor barrier adhesive.

### **3.3 Removable, Pre-fabricated, Insulation and Enclosures**

- .1 Application: At expansion joints, valves, primary flow measuring elements flanges and unions at equipment.
- .2 Design: To permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
  - .1 Insulation, fastenings and finishes: same as system.
  - .2 Jacket: high temperature fabric for indoor applications and aluminum for outdoor applications.

### **3.4 Installation of Elastomeric Insulation**

- .1 Insulation to remain dry at all times. Overlaps to manufacturer's instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

### **3.5 Piping Insulation Schedules**

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1.
  - .1 Securements: SS Bands at 300mm on centre.
  - .2 Seals: lap seal adhesive, lagging adhesive.

- .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-2.
  - .1 Securements: SS Bands at 300mm on centre.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code 1501-H.
  - .4 Direct contact with pipe and hanger is not acceptable. Install hanger outside of sheet metal protection shield covering an insert section of high density calcium silicate insulation.
- .4 TIAC Code: A-3.
  - .1 Securements: SS Bands at 300mm on centre.
  - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
  - .3 Installation: TIAC Code: 1501-C.
- .5 TIAC Code: A-6.
  - .1 Seals: lap seal adhesive, lagging adhesive.
  - .2 Installation: TIAC Code: 1501-CA; per manufacturer's recommendation.
- .6 TIAC Code: C-2 with vapour retarder jacket.
  - .1 Insulation securements: SS Bands at 300mm on centre.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code: 1501-C.
- .7 Thickness of insulation to be as listed in following table.
  - .1 Run-outs to individual units and equipment not exceeding 4000mm long.
  - .2 Do not insulate exposed run-outs to plumbing fixtures, chrome plated piping, valves, fittings.

<b>Application</b>	<b>Temp °C</b>	<b>TIAC Code</b>	<b>Run out</b>	<b>To NPS1</b>	<b>1 ¼-2</b>	<b>2 ½-4</b>	<b>5-6</b>	<b>8 &amp; over</b>
Hot Water Heating	60-94	A-1	25	38	38	38	38	38
Hot Water Heating	< 59	A-1	25	25	25	25	38	38
Domestic HW	60	A-1	25	25	25	38	38	38
Domestic CW	5	A-3	25	25	25	25	25	25

- .7 Finishes:
  - .1 Exposed indoors: Canvas or PVC jacket.
  - .2 Exposed indoor in Service Rooms: Canvas or PVC jacket.
    - .1 Service Rooms include but are not limited to mechanical equipment rooms, electrical equipment rooms, telecom/LAN rooms, janitor rooms.
  - .3 Concealed, indoors: ASJ, no further finish.
  - .4 Exposed outdoors: Aluminum jacket.

**3.6 Cleaning**

- .1 Proceed in accordance with Section 01 11 55 – General Instructions.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Related Sections**

- .1 Section 01 91 31 Commissioning (CX) Plan
- .2 Section 23 05 93 Testing, Adjusting and Balancing for HVAC

### **1.2 Quality Assurance**

- .1 The commissioning of mechanical systems shall be executed in accordance with the intent of ASHRAE Standard 1-1996 "Guideline for Commissioning of HVAC Systems"

### **1.3 General**

- .1 Commissioning of the mechanical systems, including the HVAC Systems, shall be carried out by an independent Commissioning Agent acceptable to the Departmental Representative with technicians specifically trained in commissioning procedures.
- .2 The Mechanical Subcontractor shall retain a Commissioning Agent, who shall be active in the commissioning process and actively encourage his own forces and subtrades to work together to achieve optimum system performance for the mechanical systems in a timely manner. Refer to Commissioning Authority Plan for responsibilities of Commissioning Agent.
- .3 It is not intended that this work shall, in any way, replace normal factory start-up service for equipment or relieve the Contractor or his sub-trades of their responsibility for providing first-class installation in satisfactory working order.
- .4 As part of the final commissioning report, submit a Certificate stating that the commissioning procedures have been completed, that complete factual reports have been distributed and that directions have been given to the Contractor to correct faults and omissions and finally, that follow-up testing, after the correction of faults and omissions has been completed and recorded.
- .5 Be responsible for the performance and commissioning of all equipment supplied under the Sections of Division 22 and 6. Commissioning is the process of advancing the installation from the stage of static completion to full working order in accordance with the contract documents and design intent. It is the activation of the completed installation.
- .6 In consultation with the General Contractor, ensure that sufficient time is allowed and fully identified on the construction schedule for the proper commissioning of all mechanical systems.

### **1.4 Commissioning and Demonstration**

- .1 Submit a schedule for the commissioning phase of the work. This schedule shall show:
  - .1 Equipment start-up schedule.
  - .2 Submission dates for the various documents required prior to substantial completion.
  - .3 Timing of the commissioning, testing, balancing, and demonstration process.
- .2 Commissioning is concluded when the air system is balanced and the installation is in full working order and acceptable for use. The work shall include the following:
  - .1 Balancing of the air systems as specified in this section.

- .2 Set up air diffusers, registers and grilles for optimum distribution/comfort.
- .3 Plug all air pressure and flow measuring holes.
- .4 Adjust vibration isolators and earthquake restraints for optimum performance.
- .5 Verification and certification of the sealing of all HVAC penetrations through fire separations rated & non-rated and sound separations.
- .6 Verification that coil drain pan operates.
- .7 Set up and test all alarm and protective devices.
- .8 Control Systems:
  - .1 Commissioning of control systems is primarily responsible by Controls Contractor. Refer to Section 23 09 33 Electric and Electronic Control System for HVAC.
  - .2 The Commissioning Agent shall assign one person experienced and qualified in commissioning control systems through practical experience and a comprehensive knowledge of the interactive nature of HVAC systems to verify the performance of the control systems by conducting random tests of the control sequences until the Commissioning Agent is satisfied that the controls are performing according to the intended control sequences.
- .3 At the conclusion of commissioning, demonstrate the operation of the systems to the Departmental Representative. For demonstration and instruction to Operating staff requirements, refer to this section of the specification
- .4 The verification process shall include the demonstration of the following:
  - .1 The ease of access that has been provided throughout for servicing coils, motors, drives, control dampers and damper operators.
  - .2 Location of and opening and closing of all access panels.
  - .3 Operation of all automatic control dampers and automatic temperature control devices.
  - .4 Operation of all alarm and protective devices.
  - .5 Operation of all equipment and systems under each mode of operation, and failure.
- .5 At the completion of commissioning, testing, balancing and demonstration submit the following to the Departmental Representative:
  - .1 A letter certifying that all work specified under this contract is complete, clean and operational in accordance with the specification and drawings.
  - .2 Completed copies of all commissioning check lists plus copies of start-up reports from specialty contractors and vendors.
  - .3 "As-Built" record drawings, as specified.
  - .4 A list of all alarm and protective devices tested, with the final operating settings.
- .6 Training
  - .1 During "Substantial Performance" review, the Mechanical Contractor, Control Sub-contractor, and other Sub-contractors designated by the Departmental Representative shall provide training to the Owner's operating personnel in the

proper operation and maintenance of all systems and equipment installed under the contract.

- .2 It shall be the Mechanical Contractor's responsibility to have the specified equipment manuals prepared, previously approved by the Departmental Representative, and ready for presentation to the Owner at this meeting.
- .3 Convene the meeting with the aforementioned parties at the time called for in the substantial performance review. The arrangements shall include written notices to all the parties concerned. Should the equipment manuals, or system installation not be complete and operable at the proper time, he shall then convene the operating instruction meeting at a later date and pay any additional costs including time and traveling expenses for the personnel involved which are attributable to the delay.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 Related Sections**

- .1 Section 01 91 00 Commissioning
- .2 Section 22 42 01 Plumbing Specialties and Accessories
- .3 Section 23 05 93 Testing, Adjusting and Balancing for HVAC
- .4 Section 23 08 00 Commissioning of Mechanical Systems
- .5 Section 23 08 02 Cleaning and Start-up of Mechanical Piping Systems
- .6 This Section applies to all related work under Divisions 22 and 23.

### **1.2 References**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM E202-12, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

### **1.3 Cleaning and Start-up of Mechanical Piping Systems**

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

### **1.4 Hydronic Systems – Performance Verification (PV)**

- .1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.
- .2 When systems are operational, perform following tests:
  - .1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
  - .2 Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
    - .1 Pump operation.
    - .2 Boiler and/or chiller operation.
    - .3 Pressure bypass open/closed.
    - .4 Control pressure failure.
    - .5 Maximum heating demand.
    - .6 Maximum cooling demand.
    - .7 Boiler and/or chiller failure.
    - .8 Cooling tower (and/or industrial fluid cooler) fan failure.
    - .9 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.



## 1.5 Hydronic System Capacity Test

- .1 Perform hydronic system capacity tests after:
  - .1 TAB has been completed
  - .2 Verification of operating, limit, safety controls.
  - .3 Verification of primary and secondary pump flow rates.
  - .4 Verification of accuracy of temperature and pressure sensors and gauges.
- .2 Calculate system capacity at test conditions.
- .3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.
- .4 When capacity test is completed, return controls and equipment status to normal operating conditions.
- .5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.
- .6 Heating system capacity test:
  - .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
    - .1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions) or
    - .2 Reducing space temperature by turning of heating system for sufficient period of time before starting testing.
  - .2 Test procedures:
    - .1 Open fully heat exchanger, heating coil and radiation control valves.
    - .2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.
    - .3 Conduct flue gas analysis test on boilers at full load and at low fire conditions.

## 1.6 Condenser Water and Humidification Systems

- .1 In addition to procedures specified above, perform following:
  - .1 Add chemicals once per week as required.
  - .2 Perform TAB as specified Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .3 Set up and adjust drip feeders, timer controls, pump strokes as required to maintain required chemical feed rates.
  - .4 Inject inhibitor into cooling tower sump.

### **1.7 Glycol Systems**

- .1 Test to prove concentration will prevent freezing to minus 40°C. Test inhibitor strength and include in procedural report. Refer to ASTM E 202.

### **1.8 Steam Systems**

- .1 Performance verification:
  - .1 When systems are operational, perform relevant tests of steam and condensate return piping systems as specified under hydronic systems.
  - .2 Verify operation of components of steam system including:
    - .1 Steam traps by:
      - .1 Measuring temperature of condensate return and/or
      - .2 Using audio-sensing devices.
      - .3 Use of other approved methods.
    - .2 Flash tanks.
    - .3 Thermostatic vents.
  - .3 Verify performance of condensation units, including:
    - .1 Pump capacity at design temperature.
    - .2 Controls.
  - .4 Verify performance of condensate return system to ensure return of maximum quantity of condensate return water at with minimum temperature drop.
  - .5 Adjust piping system as required to eliminate water hammer.
- .2 Monitor system continuously until acceptance for proper operation of components including steam traps, thermostatic vents, flash tanks and condensate pumping units.

### **1.9 Gaseous Fuel Systems**

- .1 Operation tests:
  - .1 Measure gas pressure at gas meter outlet and at burner manifold.
  - .2 Verify details of temperature and pressure compensation at meter.
  - .3 Verify settings, operation, venting of high and low pressure cut-outs, alarms.
  - .4 Check terminals of vents for gas pressure regulators.

### **1.10 Fuel Oil Systems**

- .1 Environmental protection systems:
  - .1 Test oil storage tank leakage detection system using manufacturer's recommended procedures.
  - .2 Test spill protection and over-fill protection systems using manufacturer's recommended procedures.
- .2 Fuel oil pumps:

- .1 Check strainers on pump inlet, relief valve on pump outlet with discharge to oil return piping, pressure gauge on strainer inlet, pump inlet and pump discharge.
- .2 Verify pump performance.
- .3 Pump performance within plus 20% and minus 0% of design.
- .3 Operational Tests:
  - .1 Timing: perform at same time as 100% and 105% boiler PV tests.
  - .2 Charge system and verify operation.
  - .3 Verify adequacy of flow rates and pressure from storage facilities to burners.
  - .4 Verify accurate metering of fuel to burners.
  - .5 For further details refer to relevant sections of Division 23.
- .4 Heavy oil systems:
  - .1 Verify temperature of stored oil and of oil adjacent to suction pipe.
  - .2 Verify steam pressure at storage tank inlet.
  - .3 Verify complete heat tracing system for completeness, controls, operation.
  - .4 Verify that steam condensate is discharged to sewer after being suitably cooled.
  - .5 Heavy oil pumping and heating set:
    - .1 For test purposes and where suction lift is involved, level of oil in tank should be near empty.
    - .2 Measure oil pressure at strainer inlet and outlet, inlet and discharge of pumps, inlet and outlet of heaters.
    - .3 Measure oil temperature at inlet and outlet of heaters.
    - .4 Measure steam pressure at inlet of control valve and at inlet of heaters.
- .5 Notify authorities having jurisdiction to enable witnessing of tests as required.
- .6 Cathodic protection systems:
  - .1 Test oil storage tank and oil fill, vent, suction and return piping cathodic protection systems.

### **1.11 Potable Water Systems**

- .1 When cleaning is completed and system filled:
  - .1 Verify performance of equipment and systems as specified elsewhere in Division 22.
  - .2 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut off water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.
  - .3 Confirm water quality consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.

### **1.12 Sanitary and Storm Drainage Systems**

- .1 Buried systems: Perform tests prior to back-filling. Perform hydraulic tests to verify grades and freedom from obstructions.
- .2 Ensure that traps are fully and permanently primed.
- .3 Ensure that fixtures are properly anchored, connected to system.
- .4 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.
- .5 Cleanouts: Refer to Section 22 42 01 - Plumbing Specialties and Accessories.
- .6 Roof drains:
  - .1 Refer to Section 22 42 01 - Plumbing Specialties and Accessories.
  - .2 Remove caps as required.

### **1.13 Reports**

- .1 In accordance with Section 01 91 00 – Commissioning and Section 23 08 00 – Commissioning of Mechanical Systems

## **PART 2 - PRODUCTS**

### **2.1 Not Used**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 Not Used**

- .1 Not Used.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 Related Sections**

- .1 Section 01 11 55 General Instructions
- .2 Section 01 35 33 Health and Safety Requirements
- .3 Section 23 05 00 Common Work Results-Mechanical
- .4 Section 23 05 93 Testing Adjusting and Balancing
- .5 Section 23 25 00 HVAC Water Treatment Systems

### **1.2 References**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM E 202-12, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

### **1.3 Submittals**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 11 55 – General Instructions. Include product characteristics, performance criteria, and limitations.
- .2 Quality assurance submittals: submit following in accordance with Section 01 11 55 – General Instructions.
  - .1 Instructions: submit manufacturer's installation instructions.

### **1.4 Quality Assurance**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

### **1.5 Delivery, Storage, and Handling**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse recycling in accordance with Section 01 11 55 – General Instructions.

## **PART 2 PRODUCTS**

### **2.1 Cleaning Solutions and Chemicals**

- .1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.
- .2 Sodium carbonate: 0.40 kg per 100 L water in system.
- .3 Low-foaming detergent: 0.01 kg per 100 L water in system.
- .4 Cleaning solutions shall be provided by the supplier of chemicals for water treatment under Section 23 25 00 – HVAC Water Treatment Systems.

## **PART 3 EXECUTION**

### **3.1 Manufacturer's Instructions**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.2 Cleaning of Hydronic Systems**

- .1 Timing:
  - .1 Systems to be operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.
- .2 Cleaning Agency:
  - .1 Retain qualified water treatment specialist to perform system cleaning.
- .3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist. Install cross upstream per manufacturer's recommendation. Install plugs in unused connections.
- .4 Cleaning procedures:
  - .1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:
    - .1 Cleaning procedures, flow rates, elapsed time.
    - .2 Chemicals and concentrations to be used. Include Material Safety Data Sheets (MSDS).
    - .3 Inhibitors and concentrations.
    - .4 Specific requirements for completion of work.
    - .5 Special precautions for protecting piping system materials and components.
    - .6 Complete analysis of water to be used to ensure water will not damage systems or equipment.

- .5 Conditions at time of cleaning of systems:
  - .1 Systems to be free from construction debris, dirt and other foreign material.
  - .2 Control valves to be operational, fully open to ensure that terminal units can be cleaned properly.
  - .3 Strainers to be clean prior to initial fill.
- .6 Report on Completion of Cleaning:
  - .1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.
- .7 Hydronic System:
  - .1 Fill system with water, ensure air is vented from system.
  - .2 Provide drain connections to drain system in one hour. All drains for chemical treatment shall be piped to the nearest floor drain. After initial flushing has been completed, clean all strainer screens.
  - .3 System pumps may be used for circulating cleaning solution provided that pumps are dismantled and inspected, worn parts repaired with new gaskets and seals install. Submit used seals.
  - .4 Add cleaners and chemicals to closed systems at concentration levels recommended by the Chemical Specialist.
  - .5 For heating hot water systems, apply heat while circulating, raise temperature slowly to 70°C [158°F] and maintain at 70°C [158°F] for a minimum of 12 hours. Remove heat and continue to circulate until temperature is below 38°C [100°F].

### **3.3 Start-up of Hydronic Systems**

- .1 After cleaning is completed and system is filled:
  - .1 Establish circulation and expansion tank level, set pressure controls.
  - .2 Ensure air is removed.
  - .3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
  - .4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.
  - .5 Clean out strainers repeatedly until system is clean.
  - .6 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment Systems.
  - .7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
  - .8 Repeat with water at design temperature.
  - .9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
  - .10 Bring system up to design temperature and pressure slowly over a 48 hour period.

- .11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing.
- .12 Adjust pipe supports, hangers, springs as necessary.
- .13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
- .14 Re-tighten bolts, etc. using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
- .15 Check operation of drain valves.
- .16 Adjust valve stem packings as systems settle down.
- .17 Fully open all balancing valves (except those that are factory-set).
- .18 Check operation of over-temperature protection devices on circulating pumps.
- .19 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

### **3.4 Cleaning**

- .1 Proceed in accordance with Section 01 11 55 – General Instructions.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**



## **1 GENERAL**

### **1.1 Related Sections**

- |    |                  |   |
|----|------------------|---|
| .1 | Section 01 33 00 | Shop Drawings, Product Data and Samples               |
| .2 | Section 01 35 33 | Health and Safety Requirements                        |
| .3 | Section 01 61 00 | Product Requirements                                  |
| .4 | Section 01 74 19 | Waste Management and Disposal                         |
| .5 | Section 01 78 30 | Closeout Submittals                                   |
| .6 | Section 01 91 31 | Commissioning (Cx) Plan                               |
| .7 | Section 23 05 05 | Installation of Pipework                              |
| .8 | Section 23 08 00 | Commissioning   |
| .9 | Section 23 08 01 | Performance Verification of Mechanical Piping Systems |

### **1.2 References**

- .1 American National Standards Institute (ANSI)
  - .1 ANSI/IEEE C57.13-1978(R1987), Requirements for Instrument Transformers.
  - .2 National Electrical Manufacturer's Association (NEMA)

### **1.3 Submittals**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples. Include product characteristics, performance criteria, and limitations.
  - .2 Include:
    - .1 Information as specified for each device.
    - .2 Manufacturer's detailed installation instructions.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 – Shop Drawings, Product Data & Samples.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.

### **1.4 Quality Assurance**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

### **1.5 Delivery, Storage and Handling**

- .1 Packing, shipping, handling and unloading:

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

## **1.6 Waste Management Disposal**

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.
- .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan
- .3 Fold up metal banding, flatten and place in designated area for recycling.

## **2 PRODUCTS**

### **2.1 Thermostats**

- .1 Low voltage, seven day, 24 hour programmable wall thermostat as supplied with equipment.
- .2 Line voltage, heavy duty, reverse acting.

### **2.2 Thermostat Guards**

- .1 Thermostat guards: lockable, clear plastic. Slots for air circulation to thermostat.

### **2.3 Dehumidistat**

- .1 24/120/240Vac Wall Mounted Dehumidistat.
- .2 Fully enclosed, SPST, snap-acting, dust-proof switch.
- 3. Positive ON-OFF settings to permit manual operation of controlled equipment.

### **2.4 Time Switch (Clock Type)**

- .1 All programmable time switches shall be seven day, 24 hour program type with carry over feature capable of accepting settings to nearest 15 minutes with minimum "on" cycle of 45 minutes.
- .2 Where specified, manual override timers shall be clockwork type without "hold" position, calibrated for 1 to 4 hours timing duration. Mount adjacent to the programmable timer. Alternatively, the override switch may be built in with the programmable unit and readily accessible with a selectable 1 to 4 hour duration.

## 2.5 Dampers and Actuators

- .1 All control dampers not furnished with packaged equipment shall be supplied by the controls subcontractor and installed by the sheet metal subcontractor. Provide damper actuators for all dampers shown or specified.
- .2 All dampers in a mixing application shall be parallel blade with direction of closing producing opposed air streams for optimal mixing. Return air dampers shall be a tight closing, low leakage type with replaceable blade and edge seals.
- .3 All dampers for outdoor air application shall be parallel blade, insulated, tight closing, low leakage type with replaceable blade and edge seals.
- .4 Actuators shall be electronic, direct coupled. Control voltage shall be 0-10 VDC, or 4-20 mA with an internal spring return on power failure. Actuators shall permit manual positioning of damper when actuator is not powered.

## 2.6 Electrical Components, and Conduit

- .1 Provide all control system components, except those supplied as part of packaged equipment controls, but including all auto sequencing devices, electric relays, safety devices and electrical interlocks required to accomplish specified sequences. Refer to the electrical motor schedule in the electrical drawings and/or specification, which delineate the limits of electrical work in Division 26 (Electrical) serving mechanical systems.
- .2 Provide all control circuit transformers required for control systems and not supplied by Division 26 including line voltage power connection from indicated outlets shall be included by Division 23.
- .3 All line voltage wiring shall be copper with RW90 X-Link P.E. insulation #12 minimum size. AWG wire shall be sized to meet code.
- .4 Wiring shall be in conduit in all wall spaces and exposed locations as well as in pipe chases, service spaces, attics, and crawl spaces which are entered for service access. Wiring in suspended ceiling spaces does not require conduit but shall be neatly installed parallel to building lines using bridle rings. All wiring installed under this contract shall be plenum rated FT-6 or FT-4, if approved by all authorities having jurisdiction. Locate wiring away from top or bottom of ceiling joists or trusses to minimize possibility of accidental damage. Number 18 gauge wire may be used in Class 2 circuits unless voltage drops are excessive. THHN wire will not be acceptable. Twisted shielded wiring, minimum of 22 gauge wire shall be used for all DDC or co-axial communication wiring. Line voltage alternating current wiring shall not be run in the same conduit, or cabling as DDC wiring.
- .5 Use 1m of flexible conduit for all connections to vibrating equipment. Use liquid tight flex cable and connections where required.
- .6 The Control Contractor shall locate magnetic starters from the electrical drawings. All electrical work provided by this Contractor shall comply with all requirements of the Division 16 electrical specification, the Canadian Electrical Code and Local Codes and Ordinances.
- .7 Wire all line voltage thermostats for single phase equipment.
- .8 Division 26 has been requested to provide specific devices, including magnetic starters supplied with 120 volt holding coils, HOA switching and space for the addition of auxiliary contacts. The Control Contractor shall provide all necessary normally open and

normally closed contacts, wired to a terminal strip within the starter enclosure, required to achieve the specified control interlocking and sequencing. Manual starters for 120 volt equipment are to contain On-Off selector, external H.O.A., integral overload protection and pilot lights. The Controls Contractor shall provide control wiring interlocks from the control contacts provided on the automatic branch lines of the assembly, which will be contained within the associated Motor Control or Starter Assembly.

- .9 Refer to Division 26 Specifications and Motor Schedule for the scope of work to be provided by the Electrical Contractor. Division 23 shall supply and install all components, in addition to those outlined within the Division 26 documents, as may be deemed necessary to provide all interlocks or sequences as called for elsewhere within the specifications.
- .10 All power supplies for controls are this Contractor's responsibility unless otherwise specified in the Electrical Specifications. All control transformers to be located in fan rooms or mechanical rooms only and are to be mounted in serviceable locations.
- .11 Line voltage will not be run with signal or trunk wiring or be present in the same junction box.
- .12 Run all wiring parallel to building lines. All wiring to be installed in a neat, workmanlike manner.
- .13 Support wiring independent of piping, ductwork, and equipment. Keep wiring clear of hot piping, ductwork/equipment.
- .14 Identify all junction boxes with control company label.
- .15 There shall be no splices in any of the control wiring except at devices or control panels.

### **3 EXECUTION**

#### **3.1 Manufacturer's Instructions**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

#### **3.2 Installation**

- .1 Check and verify location of thermostats and other exposed control sensors with plans and room details before installation. Locate thermostats and temperature sensors 1.5m above floor.
- .2 Install damper motors on outside of ducts. Do not locate inside air stream.
- .3 The installation shall conform to each manufacturer's recommended procedures and to all applicable codes, statutes and ordinances.
- .4 Equipment shall be installed so as to allow for easy maintenance access. Equipment shall be installed such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.
- .5 All transmitters, interfaces, terminations and control relays, etc. shall be mounted in field cabinets that may be locked.

- .6 Equipment shall be installed in locations providing adequate ambient conditions for its specified functioning, allowing for adequate ventilation.
- .7 Permanently identify each wire, cable, conduit and tube at each terminal.
- .8 All wall mounted devices in new finished space shall be mounted in a recessed wall box.

### **3.3 Commissioning**

- .1 Proceed in accordance with Section 01 91 31 and Section 23 08 00.

### **3.4 Cleaning**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 Related Sections**

- |    |                  |  |
|----|------------------|--|
| .1 | Section 01 11 55 | General Instructions                               |
| .2 | Section 01 35 33 | Health and Safety Requirements                     |
| .3 | Section 23 05 00 | Common Work Results - Mechanical                   |
| .4 | Section 23 05 05 | Installation of Pipework                           |
| .5 | Section 23 05 93 | Testing, Adjusting and Balancing for HVAC          |
| .6 | Section 23 08 01 | Performance Verification of Mechanical Piping      |
| .7 | Section 23 08 02 | Cleaning and Start-up of Mechanical Piping Systems |

### **1.2 References**

- .1 American Society of Mechanical Engineers (ASME).
  - .1 ASME Boiler and Pressure Vessel Code, 2013.
- .2 American Society for Testing and Materials, (ASTM).
  - .1 ASTM A47/A47M-09, Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A278/278M-01(2011), Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650°F (350°C).
  - .3 ASTM A516/A516M-10, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
  - .4 ASTM A536-11, Standard Specification for Ductile Iron Castings.
  - .5 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .3 Canadian Standards Association (CSA International).
  - .1 CSA B51-14, Boiler, Pressure Vessel, and Pressure Piping Code.

### **1.3 Submittals**

- .1 Submit shop drawings in accordance with Section 01 11 55 – General Instructions.
- .2 Closeout Submittals:
  - .1 Submit maintenance data in accordance with Section 01 11 55 – General Instructions.

### **1.4 Quality Assurance**

- .1 Health and Safety.
  - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

## **1.5 Delivery Storage and Handling**

- .1 Waste Management and Disposal.
  - .1 Separate waste materials for reuse and recycling in accordance with 01 11 55 – General Instructions.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
  - .4 Fold up metal and plastic banding, flatten and place in designated area for recycling.

## **PART 2 PRODUCTS**

### **2.1 Diaphragm Type Expansion Tank**

- .1 Steel pressurized diaphragm type expansion tank. Expansion tank shall be vertical or horizontal as indicated.
- .2 Capacity and size as indicated.
- .3 Diaphragm sealed in elastomer suitable for 115°C [240°F] operating temperature.
- .4 Working pressure: 862 kPa [125 PSI] with ASME stamp and certification.
- .5 Air pre-charged to 84 kPa [12 PSI].
- .6 Supports: provide supports with hold down bolts and installation templates incorporating seismic restraint systems.

### **2.2 Bladder Type Expansion Tank**

- .1 Steel pressurized replaceable bladder type expansion tank. Expansion tank shall be vertical or horizontal as indicated with top connection.
- .2 Capacity and size as indicated.
- .3 Bladder in heavy duty butyl suitable for 115°C [240°F] operating temperature.
- .4 Working pressure: 862 kPa [125 PSI] with ASME stamp and certification.
- .5 Air pre-charged to 84 kPa [12 PSI].
- .6 Supports: provide supports with hold down bolts and installation templates incorporating seismic restraint systems.

### **2.3 Manual Air Vent**

- .1 Disc vent: with built-in check valve, NPT 1/8 connection. Rated at 345 kPa [50 PSI] working pressure.

## **2.4 Automatic Air Vent**

- .1 Float vent: brass body, stainless steel float, NPT 3/4 connection, with built-in check valve. Rated at 1,034 kPa [150 PSI] working pressure and 121°C [250°F] operating temperature.
- .2 High capacity vent: cast iron body, stainless steel float and NPS 3/4 connection. Rated at 1,034 kPa [150 PSI] working pressure and 121°C [250°F] operating temperature.

## **2.5 Combination Low Pressure Relief and Reducing Valve**

- .1 Adjustable pressure setting: 206 kPa [30 PSI] relief, 55 to 172 kPa [8 to 25 PSI] reducing.
- .2 Low inlet pressure check valve.
- .3 Removable strainer.

## **2.6 Strainer**

- .1 NPS 1/2 to 2: Y-type, bronze body to ASTM B62, screwed connections, 304 stainless steel screen with 20 mesh perforations.
- .2 NPS 2 1/2 to 12: Y-type, cast iron body to ASTM A126 Class B, flanged connections, 304 stainless steel screen with 20 mesh perforations.
- .3 NPS 2 to 12: T-type, cast iron body to ASTM A126 Class B, flanged connections, 304 stainless steel screen with 0.063 perforations for NPS 2 to 4, and 0.125 perforations for NPS 6 and larger.
- .4 Working pressure: 1,034 kPa [150 PSI].
- .5 Provide blow-down valve with capped hose adapter fitting and chain.

## **2.7 Backflow Preventer**

- .1 To CSA-B64 series.
- .2 Application: as indicated.

## **2.8 Air Separator – Boiler Mounted**

- .1 Complete with dip tube.
- .2 Working pressure: [860] kPa.

## **2.9 Air Separator – Expansion Tank Fitting**

- .1 Complete with adjustable vent tube and built-in manual vent valve.
- .2 Working pressure: [860] kPa.
- .3 Size: line size.

## **2.10 Air Separator – In-line Air Scoop**

- .1 Construction: cast iron.
- .2 Working pressure: [860] kPa.
- .3 Size: line size.



### **2.11 Air Separator**

- .1 Steel, tested and stamped in accordance with ANSI/ASME BPVC, for [860] kPa operating pressure, with galvanized steel integral strainer with [5] mm perforations, tangential inlet and outlet connections, and internal stainless steel air collector tube.

### **2.12 Air & Dirt Separator**

- .1 Steel, tested and stamped in accordance with ANSI/ASME BPVC, for [860] kPa operating pressure, with high surface pall ring, air vent, flushing cock and blowdown valve.

### **2.13 Low Loss, Primary Secondary Header**

- .1 Provide low loss, primary secondary headers, hydrostatically tested to 150 psig. Each header shall be complete with purge valve at the bottom of the vessel and an air automatic vent at the top of the vessel.
- .2 Construction: steel.
- .3 Connection: ANSI 150 class flange.
- .4 Insulation: polyurethane foam.

## **PART 3 EXECUTION**

### **3.1 General**

- .1 Install as indicated and to manufacturer's recommendations.
- .2 Run drain lines and blow off connections to terminate above nearest drain.
- .3 Maintain proper clearance to permit service and maintenance.
- .4 Should deviations beyond allowable clearances arise, request and follow Engineer's directive.
- .5 Check shop drawings for conformance of all tappings for ancillaries and for equipment operating weights.

### **3.2 Strainer**

- .1 Install in horizontal or down flow lines.
- .2 Ensure clearance for removal of basket.
- .3 Install ahead of each pump unless suction diffuser is provided.
- .4 Install ahead of each automatic control valve and as indicated.

### **3.3 Air Vents**

- .1 Install at high points of systems.
- .2 Install isolation valve on automatic air vent inlet. Run discharge to nearest drain.
- .3 Applications:
  - .1 Disc vent: radiators and convectors.

- .2 Float vent: pipe mains.
- .3 High capacity vent: air separator.

**3.4 Expansion Tank**

- .1 Adjust expansion tank pressure as indicated.
- .2 Install lock-shield type valve at inlet to tank.

**3.5 Pressure Safety Relief Valve**

- .1 Run discharge pipe to terminate above nearest drain.

**3.6 Performance Verification**

- .1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 Related Sections**

- |    |                  |  |
|----|------------------|--|
| .1 | Section 01 11 55 | General Instructions                               |
| .2 | Section 01 35 33 | Health and Safety Requirements                     |
| .3 | Section 23 05 00 | Common Work Results - Mechanical                   |
| .4 | Section 23 05 05 | Installation of Pipework                           |
| .5 | Section 23 05 93 | Testing, Adjusting and Balancing for HVAC          |
| .6 | Section 23 08 01 | Performance Verification of Mechanical Piping      |
| .7 | Section 23 08 02 | Cleaning and Start-up of Mechanical Piping Systems |

### **1.2 References**

- .1 American National Standards Institute (ANSI) / American Welding Society (AWS)
  - .1 ANSI/AWS A5.8/A5.8M-2011, Specification for Filler Metals for Brazing and Braze Welding.
- .2 American Society of Mechanical Engineers (ASME).
  - .1 ASME B1.20.1-2013, Pipe Threads, General Purpose, Inch.
  - .2 ASME B16.1-05(2009), Cast Iron Pipe Flanges and Flanged Fittings.
  - .3 ASME B16.3-2011, Malleable Iron Threaded Fittings, Classes 150 and 300.
  - .4 ASME B16.5-2013, Pipe Flanges and Flanged Fittings.
  - .5 ASME B16.9-2012, Factory-Made Wrought Steel Buttwelding Fittings.
  - .6 ASME B16.15-2013, Cast Copper Alloy Threaded Fittings.
  - .7 ASME B16.18-2012, Cast Copper Alloy, Solder Joint Pressure Fittings.
  - .8 ASME B16.22-2013, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
  - .9 ASME B16.25-2012, Buttwelding Ends.
  - .10 ASME B18.2.1-2003, Square and Hex Bolts and Screws (Inch Series).
  - .11 ASME B18.2.2-2010, Square and Hex Nuts (Inch Series).
- .3 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM A47/A47M-09, Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
  - .3 ASTM A126-04(2009), Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  - .4 ASTM A536-11, Standard Specification for Ductile Iron Castings.
  - .5 ASTM B32-08, Standard Specification for Solder Metal.

- .6 ASTM B61-08(2013), Standard Specification for Steam or Valve Bronze Castings.
- .7 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .8 ASTM B371/B371M-08(2013), Standard Specification for Copper-Zinc Silicon Alloy Rod.
- .4 American Water Works Association (AWWA).
  - .1 AWWA C111-12, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .5 Canadian Standards Association (CSA International).
  - .1 CSA B242-M1980(R1998), Groove and Shoulder Type Mechanical Pipe Couplings.
  - .2 CAN/CSA W48-06(R2011), Filler Metals and Allied Materials for Metal Arc Welding.
- .6 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).
  - .1 MSS-SP-67-2002a, Butterfly Valves.
  - .2 MSS-SP-70-2006, Cast Iron Gate Valves, Flanged and Threaded Ends.
  - .3 MSS-SP-71-2005, Cast Iron Swing Check Valves Flanged and Threaded Ends.
  - .4 MSS-SP-80-2008, Bronze Gate, Globe, Angle and Check Valves.
  - .5 MSS-SP-85-2002, Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.

### **1.3 Submittals**

- .1 Submit shop drawings in accordance with Section 01 11 55 – General Instructions.

### **1.4 Quality Assurance**

- .1 Health and Safety.
  - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

### **1.5 Delivery Storage and Handling**

- .1 Waste Management and Disposal.
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 11 55 – General Instructions.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
  - .4 Fold up metal and plastic banding, flatten and place in designated area for recycling.

## 1.6 Maintenance

- .1 Extra Materials.
  - .1 Provide following spare parts:
    - .1 Valve seats: one for every ten valves, each size. Minimum one.
    - .2 Discs: one for every ten valves, each size. Minimum one.
    - .3 Stem packing: one for every ten valves, each size. Minimum one.
    - .4 Valve handles: two of each size.
    - .5 Gaskets for flanges: one for every ten flanges.

## PART 2 PRODUCTS

### 2.1 Steel Pipe

- .1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
  - .1 To NPS 10: Schedule 40.
  - .2 NPS 12 and over: 10 mm [3/8"] wall thickness.
- .2 Joints
  - .1 NPS 2 and under: screwed fittings to ANSI/ASME B1.20.1.
  - .2 NPS 2-1/2 and over: welding fittings and flanges to ANSI/ASME D1.1, ANSI/ASME Section 9 and CAN/CSA W48.
  - .3 Pipe thread: taper.
  - .4 Flanges: weld neck, raised face to AWWA C111.
  - .5 Orifice flanges: slip-on, raised face.
  - .6 Flange gaskets: to AWWA C111.
  - .7 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.
  - .8 Nipples: extra heavy black steel.
- .3 Fittings
  - .1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.
  - .2 Pipe flanges and flanged fittings:
    - .1 Cast iron: to ASME B16.1, Class 125.
    - .2 Steel: to ASME B16.5.
  - .3 Butt-welding fittings: steel, to ASME B16.9.
  - .4 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3.
  - .5 Fittings for roll grooved piping (only to be used at for equipment with grooved connection): malleable iron to ASTM A47/A47M; ductile iron to ASTM A536.

## 2.2 Copper Pipe

- .1 Pipe NPS 3 and under: Type L hard drawn copper tubing to ASTM B88M;
  - .1 Copper piping can be used for existing system with copper piping.
- .2 Fittings
  - .1 Cast bronze threaded fittings: to ANSI/ASME B16.15.
  - .2 Wrought copper and copper alloy solder joint pressure fittings: to ANSI/ASME B16.22.
  - .3 Cast iron threaded fittings: to ANSI/ASME B16.4.
  - .4 Cast copper alloy solder joint pressure fittings: to ANSI B16.18.
- .3 Flanges
  - .1 Brass or bronze: threaded.
  - .2 Cast iron: threaded.
  - .3 Orifice flanges: slip-on, raised face, 2100 kPa.
- .4 Joints
  - .1 Solder, tin-antimony, 95:5: to ASTM B 32.
  - .2 Silver solder BCUP: to ANSI/AWS A5.8.
  - .3 Brazing: as indicated.

## 2.3 Valves

- .1 Gate valves: to MSS-SP-70 and MSS-SP-80:
  - .1 NPS 2 and under: Class 150 to MSS-SP80. Rising stem, threaded, union bonnet and solid wedge. Body, bonnet and wedge shall be of bronze ASTM B62. Stem shall be of dezincification-resistant silicon bronze ASTM B371 or low-zinc alloy B-99.
  - .2 NPS 2-1/2 and over: Class 150 to MSS-SP70. OS&Y, flanged, bolted bonnet, solid wedge, iron body, bronze trimmed, with body and bonnet conforming to ASTM A126 Class B cast iron.
- .2 Drain valves:
  - .1 Ball type, Class 150 to MSS-SP-110, 2-piece cast bronze body, threaded, full port, anti-blowout stem, stainless steel ball and stem, 20mm [3/4"] hose connection with cap and chain.
- .3 Swing check valves:
  - .1 NPS 2 and under: Class 150 to MSS-SP-80. Swing type, Y-pattern, threaded, bronze body to ASTM B-62, renewable TFE seat and disc, regrinding type, dezincification-resistant.
  - .2 NPS 2-1/2 and over: Class 125 to MSS-SP-71. Swing type, flanged, cast iron to ASTM A126 Class B, renewable bronze seat disc.

- .4 Silent check valves:
  - .1 NPS 2 and under: Class 125 to MSS-SP-80. Inline lift type, threaded, bronze body to ASTM B-584, TFE disc, stainless steel stem, spring, disc holder and seat screw, dezincification-resistant.
  - .2 NPS 2-1/2 and over: Class 125 to MSS-SP-71. Globe style, flanged, cast iron to ASTM A126 Class B, renewable bronze seat (bonded with Buna-N) and disc, stainless steel spring.
- .5 Ball valves:
  - .1 NPS 2 and under: Class 150 to MSS-SP-110. Cast bronze, 2-piece body, threaded, full port, anti-blowout stem, 316 stainless steel stem and ball (vented), TFE packing, RTFE thrust washers and seat rings, 50mm [2"] extended blowout stem for insulated piping, lever handle with position indicator.

#### **2.4 Dielectric Coupling**

- .1 NPS 2 and under: Screwed, Schedule 40 electro zinc plated ASTM A120/A53 casing with inert self-cleaning thermoplastic liner, 300 PSI WP at 225°F.
- .2 NPS 2-1/2 and over: Flanged with isolation gaskets, washers and sleeves, 300 lb. WOG.

#### **2.5 Balancing Fittings, for TAB:**

- .1 Sizes: Calibrated balancing valves, as specified this section.
- .2 NPS 2 and under: Globe type, Y-pattern, bronze body, EPDM O-ring and NPT connections.
- .3 Flow measuring valve shall be fitted with meter readout ports with check valves and caps, digital handwheel with memory stop indicator, NPS 20 hose connection, and a nameplate bearing manufacturer's name and calibrated nameplate.
- .4 Furnished with preformed rigid polyurethane insulation.

#### **2.6 Underground Piping**

- .1 The underground piping shall be pre-insulated piping system.
- .2 The system shall consist of schedule 40 steel pipe insulated with polyurethane foam for straight sections and preformed polyurethane foam for all fittings. All pipe joints shall be socket or butt welded for 50mm [2"] and smaller, and butt welded for 65mm [2-1/2"] and larger. Pipe shall be supplied in 12.2m [40'-0"] lengths, unless shorter lengths are needed, with piping exposed at each end for field joint fabrication.
- .3 Insulation shall be 25mm [1"] thick for 150mm [6"] and small pipe, nominal 32 kg/m<sup>3</sup> [2 lbs./cu. ft.] density.
- .4 All straight sections, fittings, anchors and other accessories shall be factory fabricated to job dimensions and designed to minimize the number of field welds. Each system shall be computer analyzed by the piping system manufacturer to determine stress on the service pipe and anticipated thermal movement of the service pipe. The system design shall be in strict conformance with ANSI B31.1, latest edition. Factory trained field technical assistance shall be provided for critical periods of installation such as unloading, field joint instruction and testing.

- .5 End seals, gland seals and anchors shall be designed and factory fabricated to prevent the ingress of moisture into the system.
- .6 All straight sections of the insulated piping system shall be filament wound polyester resin/fiberglass reinforcement composite directly applied on the insulating foam. Thermoplastic casing material such as PVC or PE shall not be allowed. All fittings of the insulated piping system shall be prefabricated to minimize field joints and jacketed in a chopped spray up, polyester resin/fiberglass-reinforced composite, directly applied onto the insulating foam to as thickness related to the filament-wound jacket thickness.

## **PART 3 EXECUTION**

### **3.1 Piping Installation**

- .1 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.
- .2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping where ever practical.
- .3 Slope piping in direction of drainage and for positive venting.
- .4 Use eccentric reducers at pipe size change installed to provide positive drainage and positive venting.
- .5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
- .6 Assemble piping using fittings manufactured to ANSI standards.
- .7 Install dielectric couple between dissimilar metals on open systems.
- .8 Use long radius elbows.
- .9 Remake leaking joints using new materials. Do not caulk or cement leaking threaded joints.
- .10 Do not use thread protection couplings, close nipples, running nipples or street elbows.

### **3.2 Valve Installation**

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Install isolation valves at branch take-offs and to isolate each piece of equipment, and as indicated.
- .3 Install check valves on discharge of pumps and as indicated. Provide silent check valves in vertical pipes with downward flow and swing check valves horizontal pipes.
- .4 Install chain operators on valves NPS 2-1/2 and over where installed more than 2400mm [8'-0"] above finished floor in mechanical room(s).
- .5 Install control valves with stems in upright position unless otherwise approved. Provide adequate clearance for removal of actuators.
- .6 Swing and wafer check valves:



- .1 Install only in horizontal lines unless absolutely impractical. If installed vertically, flow shall be upwards.
- .2 Do not install in pump discharge piping.
- .7 Silent check valves:
  - .1 Install in all pump discharge lines.
  - .2 Silent check valves may be installed in vertical pipes with flow down upon Departmental Representative's review for each instance.

### **3.3 Drain Connections**

- .1 Pipe the discharge from all liquid relief valves, liquid safety valves, high capacity air vents, steam drip pan elbows, equipment blowdown, water columns, overflows and piping system drains to the nearest building drain. No drains or overflow shall discharge onto floor in the building.
- .2 Provide 20 mm [3/4"] drain valves as shown on the drawings and at all low points of piping systems. Provide 40 mm [1-1/2"] valves for pipe cleaning. Provide hose end adaptors on all drain valves.
- .3 Provide chained caps for all drain valves.
- .4 Drains from drain pans shall be DWV copper ASTM B306 32mm [1-1/4"] minimum size.
- .5 Drain and vent piping shall be of the same material as the piping system to which it is connected unless otherwise noted.

### **3.4 Cleaning, Flushing, & Start-Up**

- .1 In accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

### **3.5 Testing**

- .1 Test system in accordance with Section 23 08 01 - Performance Verification – Mechanical Piping Systems.

### **3.6 Balancing**

- .1 Balance water systems to within plus or minus 5% of design output.
- .2 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

### **3.7 Underground Piping**

- .1 Prior to ordering materials, contractor shall field verify exact lengths required. No extras will be allowed for discrepancies between site conditions and lengths indicated on drawings.
- .2 The internal pipe shall be hydrostatically tested to 150 psig. Insulation shall then be poured in place into the field weld area. All field applied insulation shall be placed only in straight sections. Field insulation of fittings shall not be acceptable. The installer shall seal the field joint area with a heat shrinkable adhesive-backed wrap or with wrappings of glass reinforcement fully saturated with a catalyzed resin identical in properties to the

factory applied resin. Backfilling shall not begin until the heat shrink wrap or the FRP lay-up has cured. All insulation and coating materials for making the field joints shall be furnished by manufacturer.

- .3 Provide trenching, backfill, concrete anchor blocks, delivery of pipe to site, and stringing along trench. Provide 100mm [4"] of tamped sand bedding to 150mm [6"] above and around the pipe.
- .4 Contractor installing pre-insulated pipe shall be trained by manufacturer representative. Installation procedures shall be in strict accordance with manufacturer's instructions.
- .5 On completion the installing contractor shall provide to the Departmental Representative a certificate stating that the underground installation has been made in accordance with the manufacturer's recommendations. Include a copy of the certificate in the O&M Manual.

### **3.8 Performance Verification**

- .1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping.

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 Section Includes**

- .1 Materials, equipment selection, installation and start up for hydronic system pumps.

### **1.2 Related Sections**

- .1 Section 01 11 55 General Instructions
- .2 Section 01 35 33 Health and Safety Requirements
- .3 Section 01 91 00 Commissioning
- .4 Section 23 05 13 Common Motor Requirements for HVAC Equipment
- .5 Section 23 05 48 Vibration & Seismic Controls for HVAC Piping & Equipment
- .6 Section 23 08 00 Commissioning of Mechanical Systems

### **1.3 References**

- .1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE).
  - .1 Standard 90.1-2013 Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 Electrical Equipment Manufacturers Advisory Council (EEMAC).
- .3 Canadian Standards Association (CSA International).
  - .1 CAN/CSA-B214-12, Installation Code for Hydronic Heating Systems.
- .4 National Electrical Manufacturers Association (NEMA).
  - .1 NEMA MG 1-2011, Motors and Generators.

### **1.4 Submittals**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 11 55 – General Instructions. Include product characteristics, performance criteria, and limitations.
- .2 Shop Drawings:
  - .1 Submit shop drawings and product data in accordance with Section 01 11 55 – General Instructions.
- .3 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.
- .4 Submit product data of pump curves for review showing point of operation.
- .5 Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.

- .6 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 11 55 – General Instructions.

### **1.5 Health and Safety**

- .1 Do construction occupational health and safety in accordance with Section 01 35 33 – Health and Safety Requirements.

### **1.6 Waste Management and Disposal**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 11 55 – General Instructions.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Separate for reuse and recycling and place in designated containers in accordance with Waste Management Plan.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

### **1.7 Extra Materials**

- .1 Provide maintenance materials in accordance with Section 01 11 55 – General Instructions.
- .2 Furnish following spare parts:
  - .1 One pump seal and casing gasket for each size and type of pump.

## **PART 2 PRODUCTS**

### **2.1 Equipment Selection**

- .1 Do component selection and sizing to CAN/CSA-B214.

### **2.2 In-Line Circulator**

- .1 Volute: cast iron, radially split, with flanged connection.
- .2 Impeller: cast bronze.
- .3 Shaft: alloy steel with copper or bronze sleeve bearing, integral thrust collar.
- .4 Seal assembly: mechanical.
- .5 Coupling: flexible self-aligning.
- .6 Design pressure: 860 kPa (125 psi).

### **2.3 Vertical In-Line Pump**

- .1 Volute: cast iron, radially split, with tapped openings for draining and gauge connections, complete with vent line or internally flushed. Provide base ring tapping for floor mounted support as specified herein. Flanged connections.

- .2 Impeller: cast bronze, enclosed type, dynamically balanced, keyed to shaft and secured in place.
- .3 Shaft: alloy steel or stainless steel with bronze sleeve bearing, integral thrust collar.
- .4 Seal assembly: mechanical.
- .5 Coupling: closed coupled. Split coupled where noted.
- .6 Design pressure: 1,200 kPa (175 psi).
- .7 Provide floor mounted support for pumps with 10 HP motor and larger.

#### **2.4 Shaft Grounding Rings**

- .1 All VFD driven pumps shall be equipped with shaft grounding rings.
- .2 Complete with mounting bracket and accessories.

### **PART 3 EXECUTION**

#### **3.1 Installation**

- .1 Do Work in accordance with CAN/CSA-B214.
- .2 In-line circulators: install as indicated by flow arrows. Support at inlet and outlet flanges or unions and per manufacturer's recommendation. Install with bearing lubrication points accessible.
- .3 Vertical in-line pump: provide support for pipe elbows, suction diffuser and pump discharge combination valve at pump suction and discharge. Install floor mounted support where specified in this Section.
- .4 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.
- .5 Pipe drain tapping to floor drain.
- .6 Install volute venting pet cock in accessible location.
- .7 Check rotation prior to start-up.
- .8 Install pressure gauge test cocks.

#### **3.2 Start-Up**

- .1 General
  - .1 In accordance with Section 01 91 00 - Commissioning, Section 23 08 00 - Commissioning of Mechanical Systems, and supplemented as specified herein.
  - .2 In accordance with manufacturer's recommendations.
- .2 Procedures:
  - .1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.
  - .2 After starting pump, check for proper, safe operation.
  - .3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

- .4 Check base for free-floating, no obstructions under base.
- .5 Run-in pumps for 12 continuous hours.
- .6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
- .7 Eliminate air from scroll casing.
- .8 Adjust water flow rate through water-cooled bearings.
- .9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
- .10 Adjust alignment of piping and conduit to ensure true flexibility at all times.
- .11 Eliminate cavitation, flashing and air entrainment.
- .12 Adjust pump shaft seals, stuffing boxes, glands.
- .13 Measure pressure drop across strainer when clean and with flow rates as finally set.
- .14 Replace seals if pump used to degrease system or if pump used for temporary heat.
- .15 Verify lubricating oil levels.

### **3.3 Performance Verification**

- .1 General
  - .1 In accordance with Section 01 91 00 - Commissioning, Section 23 08 00 – Commissioning of Mechanical Systems, and supplemented as specified herein.
- .2 Exclusions:
  - .1 This paragraph does not apply to small in-line circulators.
- .3 Assumptions: these PV procedures assume that:
  - .1 Manufacturer's performance curves are accurate.
  - .2 Valves on pump suction and discharge provide tight shut-off.
- .4 Net Positive Suction Head (NPSH):
  - .1 Application: measure NPSH for pumps which operate on open systems and with water at elevated temperatures.
  - .2 Measure using procedures prescribed in the Standard.
  - .3 Where procedures do not exist, discontinue PV, report to Departmental Representative and await instructions.
- .5 Multiple Pump Installations - Series and Parallel:
  - .1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.
- .6 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

- .7 Commissioning Reports: In accordance with Section 01 91 00 - Commissioning, Section 23 08 00 – Commissioning of Mechanical Systems, reports supplemented as specified herein. Reports to include:
  - .1 Record of point(s) of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.
  - .2 Pump performance curves (family of curves).

**END OF SECTION**

## **PART 1 GENERAL**

### **1.1 Summary**

- .1 Section Includes:
  - .1 Materials, components, equipment and chemicals for installation of complete HVAC water treatment system.

### **1.2 Related Sections**

- .1 Section 01 11 55 General Instructions
- .2 Section 01 35 33 Health and Safety Requirements
- .3 Section 23 05 00 Common Work Results-Mechanical
- .4 Section 23 08 02 Cleaning & Startup of Mechanical Piping Systems

### **1.3 References**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME Boiler and Pressure Vessel Code, Section VII – 2013.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

### **1.3 Submittals**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 – General Instructions. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 11 55 – General Instructions.
- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 11 55 – General Instructions.
- .3 Quality assurance submittals: submit following in accordance with Section 01 11 55 – General Instructions.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Closeout Submittals:
  - .1 Submit operation and maintenance data for incorporation into manual specified in Section 01 11 55 – General Instructions.
  - .2 Include following:
    - .1 Log sheets as recommended by manufacturer.



#### **1.4 Quality Assurance**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

#### **1.5 Delivery, Storage, and Handling**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse recycling in accordance with Section 01 11 55 – General Instructions.

### **PART 2 PRODUCTS**

#### **2.1 Manufacturer**

- .1 Equipment, chemicals, service provided by one supplier.

#### **2.2 Chemical Feed Piping**

- .1 Schedule 40 black steel.

#### **2.3 Shipping/Feeding Chemical Containers**

- .1 High density molded polyethylene, with liquid level graduations, cover.

#### **2.4 Water Treatment for Closed Systems**

- .1 Bypass pot feeder: 7.6 L [2 gal] capacity, constructed of heavy duty cast iron or welded steel suitable for 1,380 kPa [200 psi] working pressure, with quick opening cap and complete with NPS 3/4 connections. Isolation valves shall be installed on the inlet, outlet and drain.
- .2 Sidestream filter: Steel construction using a 250mm x 30 micron filter cartridge, with a minimum flow rate of 35 litres/minute. A flow indicator with stainless steel impeller shall be installed in conjunction with the sidestream filter. Connections shall be NPS 3/4 and all isolation valves shall be installed per manufacturer's instructions. Include 10 filter cartridges.
- .3 Totalizing make-up water meter: Cast bronze body, NPS 3/4 connections, thermoplastic rotor and gear train, rated at 1,206 kPa [175 psi] maximum operating pressure.
- .4 Provide corrosion coupon, coupon holder and cross.

#### **2.5 Chemicals**

- .1 Closed System Treatment (Hot Water, Chilled Water): Use a Borated Nitrite-Molybdate based corrosion inhibitor. Maintain levels at 200 to 400ppm. The use of Nitrite only, Molybdate only or Sulphite will not be accepted.

- .2 Cleaning solutions: as indicated in Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .3 Provide one year supply.

## **PART 3 EXECUTION**

### **3.1 Manufacturer's Instructions**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.2 Installation**

- .1 Install HVAC water treatment systems in accordance with ASME Boiler Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.
- .2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

### **3.3 Chemical Feed Piping**

- .1 Install crosses at changes in direction. Install plugs in unused connections.

### **3.4 Cleaning of Mechanical System**

- .1 Provide copy of recommended cleaning procedures and chemicals for approval by Departmental Representative, include in O&M manuals.
- .2 Thoroughly flush mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Chemicals to inhibit corrosion of various system materials and be safe to handle and use.
- .3 During circulation of cleaning solution, periodically examine and clean filters and screens and monitor changes in pressure drop across equipment.
- .4 Drain and flush system[s] until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.
- .5 Disposal of cleaning solutions to be approved by authority having jurisdiction.

### **3.5 Water Treatment Services**

- .1 Provide water treatment monitoring and consulting services for period of one year after system start-up. Service to include:
  - .1 Initial water analysis and treatment recommendations.
  - .2 System start-up assistance.
  - .3 Operating staff training.
  - .4 Visit plant every 30 days during period of operation and as required until system stabilizes and advise on treatment system performance.

- .5 Provide necessary recording charts and log sheets for one year operation.
- .6 Provide necessary laboratory and technical assistance.
- .7 Provide clear, concise, written instructions and advice to operating staff.

### **3.6 Field Quality Control**

- .1 Start-Up
  - .1 Start up water treatment systems in accordance with manufacturer's instructions.
- .2 Commissioning
  - .1 Commissioning Agency: to be installing water treatment sub-contractor.
  - .2 Timing:
    - .1 After start-up deficiencies rectified.
    - .2 After start-up and before TAB of connected systems.
  - .3 Pre-commissioning Inspections: verify:
    - .1 Presence of test equipment, reagents, chemicals, details of specific tests performed, and operating instructions.
    - .2 Suitability of log book.
    - .3 Currency and accuracy of raw water analysis.
    - .4 Required quality of treated water.
  - .4 Commissioning procedures - applicable to Water Treatment Systems:
    - .1 Establish, adjust as necessary and record automatic controls and chemical feed rates.
    - .2 Monitor performance continuously during commissioning of connected systems and until acceptance of project.
    - .3 Establish test intervals, regeneration intervals.
    - .4 Record on approved report forms commissioning procedures, test procedures, dates, times, quantities of chemicals added, raw water analysis, treated water analysis, test results, instrument readings, adjustments made, results obtained.
    - .5 Establish, monitor and adjust automatic controls and chemical feed rates as necessary.
    - .6 Visit project at specified intervals after commissioning is satisfactorily completed to verify that performance remains as set during commissioning (more often as required until system stabilizes at required level of performance).
    - .7 Advise Departmental Representative in writing on matters regarding installed water treatment systems.
- .5 Commissioning procedures - Closed Circuit Hydronic Systems:
  - .1 Analyze water in system.

- .2 Based upon an assumed rate of loss approved by Departmental Representative, establish rate of chemical feed.
- .3 Record types, quantities of chemicals applied.
- .6 Training:
  - .1 Commission systems, perform tests in presence of, and using assistance of, assigned O&M personnel.
  - .2 Train O&M personnel in softener regeneration procedures.
- .7 Certificates:
  - .1 Upon completion, furnish certificates confirming satisfactory installation and performance.
- .8 Commissioning Reports:
  - .1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, other data required by Departmental Representative.
- .9 Commissioning activities during Warranty Period:
  - .1 Check out water treatment systems on regular basis and submit written report to Departmental Representative.

### **3.5 Cleaning**

- .1 Proceed in accordance with Section 01 11 55 – General Instructions.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Related Sections**

- |    |                  |  |
|----|------------------|--|
| .1 | Section 01 74 19 | Waste Management & Disposal              |
| .2 | Section 23 05 00 | Common Work Results-Mechanical           |
| .3 | Section 23 05 93 | Testing Adjusting and Balancing for HVAC |

### **1.2 Waste Management and Disposal**

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management & Disposal.
- .2 Dispose of unused cleaning solutions at official hazardous material collections site approved by the Departmental Representative.
- .3 Do not dispose of unused cleaning solutions into sewer system, into streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.
- .4 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .5 Dispose of packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

### **1.3 Scope**

- .1 All air systems installed by this contract shall be cleaned by a Cleaning Contractor.
- .2 The Cleaning Contractor shall visit the site in the case of existing systems or shall review the drawings and specifications of new systems, in order to be fully acquainted with the scope of work and requirements before tendering. No consideration will be granted for any misunderstanding of work to be done resulting from failure to visit the site or inspect the contract documents.
- .3 The following air systems shall be cleaned, as applicable:
  - .1 Relief
  - .2 Supply
  - .3 Return
  - .4 Exhaust
  - .5 Air Conditioning
- .4 All components within each system shall be thoroughly cleaned to the Departmental Representative's satisfaction and shall include but not be limited to the following:
  - .1 Intake exhaust and relief louvres
  - .2 Bird screens
  - .3 Auto dampers
  - .4 Filter frames
  - .5 Coils
  - .6 Fans & motors - complete assembly

- .7 All plenum surfaces
- .8 Terminal heating/cooling coils
- .9 Supply air grilles, registers and diffusers
- .10 Ductwork
- .11 Mixing boxes, air terminal units
- .12 Return, exhaust and relief air grilles and diffusers.

#### **1.4 Qualifications**

- .1 Cleaning shall be performed by a cleaning service company with high capacity cleaning equipment designed specifically for the work involved, executed by personnel specifically trained for the application.

### **2 PRODUCTS**

#### **2.1 Cleaning Equipment**

- .1 Cleaning shall generally be by high capacity power vacuum.
- .2 High pressure compressed air, wire brushing and/or non-toxic solvent cleaning shall be used where dirt or scale cannot be removed otherwise.

### **3 EXECUTION**

#### **3.1 Cleaning HVAC Systems**

- .1 The Cleaning Contractor shall provide access as required for the work and shall reseal and make good any duct or insulation damaged in the process of this work.
- .2 Remove cheesecloth from grilles, etc., let over from the temporary use of the air systems.
- .3 Air systems must not be shut down without prior approval from the owner
- .4 The Cleaning Contractor shall be responsible for removing and replacing filter media. In new buildings this Contractor will remove the temporary filters and replace with new after cleaning the systems. In existing buildings this Contractor may re-use existing filter media (cleaned if possible) or new media will be provided by the Owner as established by the Departmental Representative.
- .5 The Cleaning Contractor shall mark balancing damper positions before cleaning and return them to their original position when cleaning is completed unless the system is to be balanced.
- .6 Re-install any grilles, registers and diffusers which may have been removed for cleaning purposes.

#### **3.2 Report**

- .1 After completion of the work, the Contractor shall provide four copies of a certificate stating that all systems have been cleaned as specified and that all access panels for all cleaning openings are in place. This certificate shall be placed in the Operating and Maintenance Manuals.

**END OF SECTION**

## 1 GENERAL

### 1.1 Related Sections

- |    |                  |                                       |
|----|------------------|---------------------------------------|
| .1 | Section 01 33 00 | Shop Drawings, Product Data & Samples |
| .2 | Section 01 35 33 | Health & Safety Requirements          |
| .3 | Section 01 74 19 | Waste Management & Disposal           |
| .4 | Section 23 05 00 | Common Work Results - Mechanical      |
| .5 | Section 23 07 13 | Thermal Insulation for Ducting        |

### 1.2 References

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 American Society for Testing and Materials (ASTM)
  - .1 ASTM A 480/A 480M-2003c, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
  - .2 ASTM A 635/A 635M-2002, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
  - .3 ASTM A 653/A 653M-2003, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Department of Justice Canada (Jus).
  - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33 .
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .5 National Fire Protection Agency (NFPA)
  - .1 NFPA 90A-1999, Installation of Air Conditioning and Ventilating Systems.
  - .2 NFPA 90B-1999, Installation of Warm Air Heating and Air Conditioning Systems.
  - .3 NFPA 91-1995, Standard for Exhaust System for Air Conveying of Vapours, Gases, Mists, and Non-combustible Particle Solids.
- .6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible, 2nd Edition 1995 and Addendum No. 1, 1997.
  - .2 SMACNA HVAC Duct Leakage Test Manual, 1985, Technical Research Update-92.
  - .3 IAQ Guideline for Occupied Buildings Under Construction 1995, 1st Edition.

- .7 Transport Canada (TC).
  - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

### **1.3 Submittals**

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets for the following:
  - .1 Sealants.
  - .2 Adhesive
  - .3 Duct tape.
  - .4 Duct liners.

### **1.4 Quality Assurance**

- .1 Certification of Ratings:
  - .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.

### **1.5 Delivery Storage and Handling**

- .1 Protect on site stored or installed absorptive material from moisture damage.
- .2 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management & Disposal.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
  - .4 Separate for reuse and recycling and place in designated containers in accordance with Waste Management Plan.
  - .5 Place materials defined as hazardous or toxic in designated containers.
  - .6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
  - .7 Fold up metal and plastic banding, flatten and place in designated area for recycling.



## 2 PRODUCTS

### 2.1 Seal Classification

- .1 Classification as follows:

Pressure Class	Maximum Pressure (Pa)	SMACNA Seal Class
High Pressure	1,000	[A]
Medium Pressure	750	[B]
Low Pressure	500	[B]

- .2 Seal classification:

- .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant.
- .2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.

### 2.2 Ductwork - General

- .1 Duct dimension noted on drawings are clear inside dimensions. Insulation thickness shall be as noted on the drawings.
- .2 All seams, joints and raw edges shall be sealed and covered with glassfab.
- .3 Insulation shall be applied with mechanical fasteners and suitable adhesives. Duct insulation adhesive and coatings shall be non-toxic as defined by WCB Regulations.
- .4 Round duct: with spiral seams. Sections shall be joined with a RT1 slip joint, screw fastened and sealed with no visible duct sealant to interfere with finish painting.
- .5 Exposed round duct shall be installed in a neat workmanlike manner parallel to building walls and roof with no sags or misalignment, and shall be true and round.
- .6 Ductwork downstream of low-pressure single duct air terminal units shall be constructed to 500 Pa low pressure duct.
- .7 Ductwork upstream of single duct air terminal units shall be constructed to 1,000 Pa medium pressure duct.

### 2.3 Fittings

- .1 Fabrication: to SMACNA. Fittings shall be 2 gauges heavier than connecting ductwork.
- .2 Radius elbows:
- .1 Rectangular: Centre-line radius equal to 1.5 times width of duct, with single thickness turning vanes.
- .2 Round: Centre-line radius equal to 1.5 times diameter. 5-gore for 300mm [12"] and larger; die-stamped for 254mm [10"] and smaller.
- .3 Mitered elbows, rectangular:
- .1 To 400mm [16"]: with single thickness turning vanes.
- .2 Over 400mm [16"]: with double thickness turning vanes.

- .4 Branches:
  - .1 Rectangular main and branch: 45° entry on branch.
  - .2 Round main and branch: enter main duct at 45° or with conical connection. The use of spin-in collars is not acceptable.
- .5 Transitions:
  - .1 Diverging: 20° maximum angle.
  - .2 Converging: 30° maximum angle.
- .6 Offsets: full radius elbows.
- .7 Obstruction deflectors: maintain full cross-sectional area.
- .8 Elbows in autoclave exhaust shall be un-vented, smooth radius construction with centre-line equal to 1.5 times width of duct.

## **2.4 Galvanized Steel**

- .1 Lock forming quality: to ASTM A 653, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA.
- .4 Applications:
  - .1 All supply and exhaust ductwork unless otherwise noted.

## **2.5 Aluminum**

- .1 To SMACNA. Aluminum type: 3003-H-14.
- .2 Thickness: 2 gauges heavier than gauges required for galvanized duct.
- .3 Joints: to SMACNA.
- .4 Applications:
  - .1 Rooms with high humidity, such as autoclave room: first 3,000mm (10'-0") of exhaust ducts.
  - .2 As noted on drawings.
- 5. Provide neoprene gaskets between dissimilar metals.
- .6 Do not use of sheet metal screws or other fasteners which will obstruct air flow in clothes dryer exhaust duct.

## **2.6 Hangers and Supports**

- .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500mm [20"].
- .2 Hangers, hanger configuration and attachment to structure: to SMACNA.

## **2.7 Duct Liner**

- .1 Fibrous glass duct liner: air stream side faced with FSK facing.
- .2 Rigid:
  - .1 Use on flat surfaces.

- .2 25mm [1"] or 50mm [2"] thick fibrous glass rigid board duct liner.
- .3 Density: 36 kg/m<sup>3</sup> [2.2 lb/ft<sup>3</sup>].
- .4 Thermal resistance: RSI-0.76 [R-4.3] for 25mm [1"], RSI-1.53 [R-8.7] 50mm [2"].
- .3 Flexible:
  - .1 Use on round or oval surfaces.
  - .2 25mm [1"] or 50mm [2"] thick fibrous glass blanket duct liner as indicated.
  - .3 Density: 24 kg/m<sup>3</sup> [1.5 lb/ft<sup>3</sup>].
  - .4 Thermal resistance: RSI-0.74 [R-4.2] for 25mm [1"], RSI-1.47 [R-8.3] 50mm [2"].
- .4 Fasteners shall be weld pins with metal retaining clips and square head.
- .5 Flame and smoke ratings:
  - .1 In accordance with CAN/ULC-S102:
    - .1 Maximum flame spread rating: 25.
    - .2 Maximum smoke developed rating: 50.

## 2.8 Sealant

- .1 Oil resistant, polymer-based duct sealant. Temperature range of -23°C to 65°C [-10°F to 150°F]. ULC listed and comply with NFPA 90A and NFPA 90B.
- .2 Flame and smoke ratings:
  - .1 In accordance with CAN/ULC-S102:
    - .1 Maximum flame spread rating: 25.
    - .2 Maximum smoke developed rating: 50.

## 2.9 Adhesive

- .1 Water-based vinyl copolymer adhesive. Temperature range of -23°C to 71°C [-10°F to 160°F]. ULC listed and comply with NFPA 90A and NFPA 90B. Adhesive shall be non-toxic as defined by W.C.B. Regulations.
- .2 Flame and smoke ratings:
  - .1 In accordance with CAN/ULC-S102:
    - .1 Maximum flame spread rating: 25.
    - .2 Maximum smoke developed rating: 50.

## 2.10 Duct Tape System

- .1 Two part system combined of treated woven fiberglass tape and liquid sealant/adhesive. ULC listed and comply with NFPA 90A and NFPA 90B.
- .2 Flame and smoke ratings:
  - .1 In accordance with CAN/ULC-S102:

- .1 Maximum flame spread rating: 25.
- .2 Maximum smoke developed rating: 50.

### **3 EXECUTION**

#### **3.1 General**

- .1 Do work in accordance with NFPA 90A, NFPA 90B, ASHRAE, SMACNA, and as indicated.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
- .3 Support risers in accordance with SMACNA.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.
- .7 All openings in ductwork shall be sealed with temporary duct cover during construction. Failure to maintain duct cleanliness will require the inside of all air ducts, plenums and equipment in the air stream to be cleaned with an industrial vacuum cleaner before system balancing is started.
- .8 Apply protective galvanize coating to galvanized ductwork and accessories which have been welded.
- .9 Apply duct sealer to all joints of metal ducts, connections to diffusers, plenums and flexible duct.
- .10 Provide medium pressure duct for the following:
  - .1 Ductwork serving systems with air terminal units, extending from the air handling unit discharge to the inlet of air terminal units.
  - .2 As indicated.
- .11 The use of plastic duct tape is not permitted.
- .12 Thermal insulation to Section 23 07 13 – Thermal Insulation for Ducting.

#### **3.2 Hangers**

- .1 Strap hangers: Install in accordance with SMACNA.
- .2 Rectangular duct: Extend strap hanger down on both sides of duct, turn under bottom 25mm [1"] minimum. On each strap provide two sheet metal screws on the side and one in the bottom.
- .3 Angle hangers: complete with locking nuts and washers.
- .4 Hanger spacing: to SMACNA.

- .5 Seismic restraint to Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment.

### **3.3 Duct Liner**

- .1 Install in accordance with manufacturer's recommendations, and as follows:
  - .1 Fasten to interior sheet metal surface with 100% coverage of adhesive.
  - .2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425mm on centres.
- .2 Line inside of ducts where indicated.
- .3 Duct dimensions, as indicated, are clear inside duct lining.
- .4 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations, and as follows:
  - .1 Bed tape in sealer.
  - .2 Apply two coats of sealer over tape.
- .5 Replace damaged areas of liner.
- .6 Protect leading and trailing edges of duct sections with sheet metal nosing having 15mm [1/2"] overlap and fastened to duct.
- .7 Provide 50mm [2"] liner for ductwork exposed to weather which is not insulated

### **3.4 Sealing and Taping**

- .1 Apply sealant to outside of joint to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.

**END OF SECTION**

## 1 GENERAL

### 1.1 Related Sections

- |    |                  |                                       |
|----|------------------|---------------------------------------|
| .1 | Section 01 33 00 | Shop Drawings, Product Data & Samples |
| .2 | Section 01 35 33 | Health & Safety Requirements          |
| .3 | Section 01 74 19 | Waste Management & Disposal           |
| .4 | Section 01 78 30 | Closeout Submittals                   |
| .5 | Section 23 05 00 | Common Work Results - Mechanical      |

### 1.2 References

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 1995 and Addendum No. 1, 1997.
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA 90A-2009, Installation of Air Conditioning and Ventilating Systems.
  - .2 NFPA 90B-2009, Installation of Warm Air Heating and Air Conditioning Systems.
- .3 Underwriter's Laboratories of Canada (ULC)
  - .1 CAN/ULC-S110-M86(R2001), Fire Tests for Air Ducts.
  - .2 UL 181-1996, Factory Made Air Ducts and Connectors.

### 1.3 Submittals

- .1 Submittals in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:
    - .1 Flexible connections.
    - .2 Duct access doors.
    - .3 Turning vanes.
    - .4 Instrument test ports.
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
  - .1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturer's Field Reports: manufacturer's field reports specified.
- .7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 30 - Closeout Submittals.

#### **1.4 Quality Assurance**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.

#### **1.5 Delivery, Storage and Handling**

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management & Disposal.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan (WMP).
  - .4 Separate for reuse and recycling and place in designated containers in accordance with Waste Management Plan (WMP).
  - .5 Divert unused materials from landfill to recycling facility as approved by Departmental Representative.

### **2 PRODUCTS**

#### **2.1 General**

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

#### **2.2 Flexible Duct**

- .1 General:
  - .1 UL-181 listed and labeled as Class I air duct, and complies with NFPA 90A and 90B.
- .2 Non-metallic, Insulated:
  - .1 Constructed of CPE liner duct permanently bonded to a spring steel wire helix and with factory applied fibreglass insulation, lower permeability vapour barrier and laminate jacket for low and medium pressure systems.
  - .2 Maximum rated pressure: 1,000Pa [4" w.g.] positive, 250Pa [1" w.g.] negative.
  - .3 Operating temperature: -29 to 121 °C [-20 to 250 °F].
  - .4 Thermal resistance: RSI-0.74 [R-4.2].
  - .5 Application: cold air supply duct.

- .3 Non-metallic, un-insulated:
  - .1 Constructed of supporting helix of coated spring steel wire permanently bonded to a coated woven fiberglass.
  - .2 Maximum rated pressure: 2,500Pa [10" w.g.] positive, 250Pa [1" w.g.] negative.
  - .3 Operating temperature: -18 to 121 °C [-0 to 250 °F].
  - .4 Application: warm air supply duct.

### **2.3 Flexible Duct Connectors**

- .1 Frame: galvanized sheet metal frame 0.66mm [24 gauge] thick with fabric clenched by means of double locked seams.
- .2 Fabric:
  - .1 Indoor: Fire resistant, self extinguishing, neoprene coated fibreglass fabric, temperature rated at -40°C to 90°C [-40°F to 200°F], thickness of 0.63mm [0.025"].
  - .2 Outdoor: Fire resistant, self extinguishing, DuPont Hypalon coated fibreglass fabric, temperature rated at -40°C to 120°C [-40°F to 250°F], thickness of 0.61mm [0.024"].

### **2.4 Access Doors in Ducts**

- .1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6mm [24 gauge] thick complete with sheet metal angle frame.
- .2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6mm [24 gauge] thick complete with sheet metal angle frame and 25mm [1"] thick rigid fibreglass insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
  - .1 Up to 300 x 300 mm: two sash locks complete with safety chain.
  - .2 301 to 450 mm: four sash locks complete with safety chain.
  - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
  - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.

### **2.5 Turning Vanes**

- .1 Factory-made, single or double thickness as specified elsewhere, with trailing edge. Vanes shall be constructed of same material as duct, 0.55mm [26 gauge].
- .2 Rails shall be fabricated of same material as duct, 0.66m [24 gauge]. Vanes shall be attached to rails using fasteners.

### **2.6 Instrument Test Ports**

- .1 Alloy casting with screw-in cap, neoprene gasket, 18 mm [3/4"] inside diameter opening for pitot tube or velometer.



### 3 EXECUTION

#### 3.1 Manufacturer's Instructions

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

#### 3.2 Installation

- .1 Flexible Duct
  - .1 Provide flexible duct connecting air outlets as indicated. Flexible duct with integral volume damper is not acceptable.
  - .2 Install flexible duct fully extended, without tight bends and kinks. The radius at the centre-line shall not be less than one duct diameter. Do not install in compressed state.
  - .3 Length of flexible duct shall within 1,500mm to 2,100mm (5'-0" to 7'-0").
  - .4 Provide support for flexible duct at 1,200mm (4'-0") on centre. Maximum permissible sag is 42 mm/m (1/2 inch per foot) of spacing between support. A connection to a rigid duct or equipment shall be considered a support joint.
  - .5 Sheet metal strap for flexible duct support shall be minimum 38mm (1-1/2") wide.
  - .6 Sheet metal collars to which the flexible ducts are attached shall be minimum 50mm (2") in length.
  - .7 Repair torn or damaged vapour barrier jackets approved duct tape. If the internal core is penetrated, replace the flexible duct.
  - .8 Do not use flexible duct for connecting mixing box and air terminal unit inlets.
- .2 Flexible Duct Connectors
  - .1 Install in following locations:
    - .1 Inlets and outlets to supply air units and fans.
    - .2 Inlets and outlets of exhaust and return air fans.
    - .3 As indicated.
  - .2 Length of connection: 100mm [4"].
  - .3 Minimum distance between metal parts when system in operation: 75mm [3"].
  - .4 Install in accordance with recommendations of SMACNA.
  - .5 When fan is running:
    - .1 Ducting on sides of flexible connection to be in alignment.
    - .2 Ensure slack material in flexible connection.

- .3 Access Doors in Ducts
  - .1 Size:
    - .1 610mm x 1520 mm [24"x60"] for person size entry.
    - .2 460mm x 460 mm [18"x18"] for service.
    - .3 300mm x 200mm [12"x8"] for cleaning.
    - .4 As indicated.
  - .2 Locations:
    - .1 Fire dampers and smoke dampers.
    - .2 Control dampers.
    - .3 Devices requiring maintenance.
    - .4 Required by code.
    - .5 Reheat coils.
    - .6 On both sides of turning vanes.
    - .7 At the base of all duct risers.
    - .8 At 12,000 mm [40'-0"] intervals in all duct systems, and 6,000 mm [20'-0"] intervals in horizontal exhaust ducts for cleaning purposes.
- .4 Instrument Test Ports
  - .1 Install in accordance with manufacturer's instructions.
  - .2 Locate to permit easy manipulation of instruments.
  - .3 Locations:
    - .1 For traverse readings:
      - .1 Ducted inlets to roof and wall exhausters.
      - .2 Inlets and outlets of other fan systems.
      - .3 Main and sub-main ducts.
      - .4 And as indicated.
    - .2 For temperature readings:
      - .1 At outside air intakes.
      - .2 In mixed air applications in locations.
      - .3 At inlet and outlet of coils.
      - .4 Downstream of junctions of two converging air streams of different temperatures.
      - .5 And as indicated.
- .5 Turning Vanes
  - .1 Install in accordance with manufacturer's recommendations.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Summary**

- .1 Section Includes:
  - .1 Balancing dampers for mechanical forced air ventilation and air conditioning systems.
- .2 Related Requirements
  - .1 Section 01 33 00 Shop Drawings, Product Data & Samples
  - .2 Section 23 33 00 Air Duct Accessories

### **1.2 References**

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
  - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-[1985].
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

### **1.3 Action and Informational Submittals**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Shop Drawings, Product Data & Samples. Include product characteristics, performance criteria, and limitations.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

### **1.4 Quality Assurance**

- .1 Health and Safety Requirements:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

### **1.5 Delivery, Storage and Handling**

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

## **2 PRODUCTS**

### **2.1 General**

- .1 Manufacture to SMACNA standards.

### **2.2 Splitter Dampers**

- .1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.
- .2 Single and double thickness construction.
- .3 Control rod with locking device and position indicator.
- .4 Rod configuration to prevent end from entering duct.
- .5 Pivot: piano hinge.
- .6 Folded leading edge.

### **2.3 Single Blade Dampers**

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm as indicated.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside nylon end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

### **2.4 Multi-Bladed Dampers**

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height: 100 mm as indicated.
- .4 Bearings: [pin in bronze bushings] [self-lubricating nylon].
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

### **3 EXECUTION**

#### **3.1 Manufacturer's Instructions**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions and datasheet.

#### **3.2 Installation**

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.
- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5 Dampers: vibration free.
- .6 Ensure damper operators are observable and accessible.
- .7 Corrections and adjustments conducted by Engineer.

#### **3.3 Field Quality Control**

- .1 Tests:
  - .1 Tests to cover and demonstrate that system is functioning as specified.

#### **3.4 Cleaning**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

## 1 GENERAL

### 1.1 Summary

- .1 Section Includes:
  - .1 Operating dampers for mechanical forced air ventilation and air conditioning systems.
- .2 Related Requirements
  - .1 Section 23 33 00 Air Duct Accessories
  - .2 Section 01 33 00 Shop Drawings, Product Data & Samples

### 1.2 References

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A 653/A 653M-[04a], Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

### 1.3 Action and Information Submittals

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two copies of Workplace Hazardous Materials Information in accordance with Section 01 33 00 Shop Drawings, Product Data & Samples.
  - .2 Indicate the following:
    - .1 Performance data.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
    - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
- .3 Closeout Submittals
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 30 - Closeout Submittals.

### 1.4 Quality Assurance

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

- .2 Certificates:
  - .1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency.

## **1.5 Delivery, Storage and Handling**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

## **2 PRODUCTS**

### **2.1 Multi-Leaf Dampers**

- .1 Opposed and/or parallel blade type as indicated.
- .2 Structurally formed steel, extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, structurally formed and welded galvanized steel, extruded aluminum frame.
- .3 Pressure fit self-lubricated bronze bearings.
- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- .5 Performance:
  - .1 Leakage: in closed position less than 2% of rated air flow across damper.
  - .2 Pressure drop: at full open position less than 19 Pa differential across damper at 4.5 m/s.
- .6 Insulated aluminum dampers:
  - .1 Frames: insulated with extruded polystyrene foam with RSI 0.88.
  - .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

### **2.2 Disc-Type Dampers**

- .1 Frame: insulated brake formed, welded, 1.6 mm thick, galvanized steel to ASTM A 653/A 653M.

- .2 Disc: insulated spin formed, 1.6 mm thick, galvanized steel to ASTM A 653/A 653M.
- .3 Gasket: extruded neoprene, field replaceable, with 10 year warranty.
- .4 Bearings: roller self-lubricated and sealed.
- .5 Operator: compatible with damper, linear stroke operator, spring loaded actuator, zinc-aluminum foundry alloy casting cam follower.
- .6 Performance:
  - .1 Leakage: in closed position less than 0.001 % of rated air flow.
  - .2 Pressure drop: at full open position less than 19 kPa differential across damper at 4.5 m/s.

### **2.3 Back-Draft Dampers**

- .1 Automatic gravity operated, multi single leaf, aluminum steel construction with nylon bearings, centre pivoted spring assisted or counterweighted as indicated.

### **2.4 Relief Dampers**

- .1 Automatic multi-leaf steel dampers with ball bearing centre pivoted and counter-weights set to open as indicated.

## **3 EXECUTION**

### **3.1 Manufacturer's Instructions**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.2 Installation**

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .3 Seal multiple damper modules with silicon sealant.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Ensure dampers are observable and accessible.



### **3.3 Cleaning**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

## 1 GENERAL

### 1.1 Related Sections

.1	Section 01 33 00	Shop Drawings, Product Data & Samples
.2	Section 01 35 33	Health & Safety Requirements
.3	Section 01 61 10	Product Requirements
.4	Section 01 74 19	Waste Management & Disposal
.5	Section 01 78 30	Closeout Submittals
.6	Section 01 91 31	Commissioning (CX) Plan
.7	Section 23 05 13	Common Motor Requirements for HVAC Equipment
.8	Section 23 05 48	Vibration & Seismic Controls for Ductwork Piping & Equipment
.9	Section 23 08 00	Commissioning of Mechanical Systems
.10	Section 23 33 00	Air Duct Accessories

### 1.2 References

- .1 Air Conditioning and Mechanical Contractors (AMCA)
  - .1 AMCA Publication 99-2003, Standards Handbook.
  - .2 AMCA 300-1996, Reverberant Room Method for Sound Testing of Fans.
  - .3 AMCA 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
  - .1 ANSI/AMCA 210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB 1.181-1999, Ready-Mixed Organic Zinc-Rich Coating.

### 1.3 System Description

- .1 Performance Requirements:
  - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
  - .2 Capacity: flow rate, static pressure, BHP, HP, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
  - .3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
  - .4 Sound ratings: comply with AMCA 301, tested to AMCA 300.

- .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210.

#### **1.4 Submittals**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples. Include product characteristics, performance criteria, and limitations.
- .2 Shop Drawings:
  - .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples.
- .3 Provide:
  - .1 Fan performance curves showing point of operation, BHP and efficiency.
  - .2 Sound rating data at point of operation.
- .4 Indicate:
  - .1 Motors and sheaves details.
- .5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
- .6 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 30 - Closeout Submittals.

#### **1.5 Quality Assurance**

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.

#### **1.6 Delivery, Storage and Handling**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Section 01 61 10 - Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - .3 Waste Management and Disposal:
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management & Disposal.

## **2 PRODUCTS**

### **2.1 Fans General**

- .1 Motors:
  - .1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.
  - .2 For use with variable speed controllers where specified.
  - .3 Sizes as specified.
- .2 Accessories and hardware: as specified.
- .3 Scroll casing drains: as indicated.
- .4 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .5 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for Ductwork Piping and Equipment.
- .6 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

### **2.2 Centrifugal Fans**

- .1 Fan wheels:
  - .1 welded steel construction.
  - .2 Maximum operating speed of centrifugal fans not more than 50% of first critical speed.
  - .3 Air foil or backward inclined blades, as indicated.
- .2 Bearings: heavy duty grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life (L50) of 200,000 hours.
- .3 Housings:
  - .1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, steel, for smaller wheels, braced, and with welded supports.
  - .2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.
  - .3 Provide bolted or latched airtight access doors with handles.
- .4 Provide belt driven sets with adjustable motor bed plate and variable pitch driver sheave.

### **2.3 Cabinet Fans – General Purpose**

- .1 Fan characteristics and construction: as centrifugal fans.
- .2 Cabinet hung single wheel with centrifugal fan in factory fabricated casing complete with vibration isolators and seismic control measures, motor and other accessories as noted.
- .3 Fabricate casing of zinc coated or phosphate treated steel of 18 gauge reinforced and braced for rigidity. Provide removable panels for access to interior. Paint uncoated, steel parts with corrosion resistant paint to CAN/CGSB 1.181.

## **2.4 In-Line Centrifugal Fans**

- .1 Characteristics and construction: as for centrifugal fan wheels.
- .2 Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets, and stationary guide vanes.

## **3 EXECUTION**

### **3.1 Manufacturer's Instructions**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.2 Fan Installation**

- .1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.
- .2 Provide sheaves and belts required for final air balance.
- .3 Bearings and extension tubes to be easily accessible.
- .4 Access doors and access panels to be easily accessible.

### **3.3 Anchor Bolts and Templates**

- .1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified in Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment.

### **3.4 Field Quality Control**

- .1 Commissioning:
  - .1 In accordance with Section 01 91 31 – Commissioning (CX) Plan, and Section 23 08 00 – Commissioning of Mechanical Systems.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Related Sections**

- |    |                  |                                       |
|----|------------------|---------------------------------------|
| .1 | Section 01 33 00 | Shop Drawings, Product Data & Samples |
| .2 | Section 01 35 33 | Health and Safety Requirements        |
| .3 | Section 01 74 19 | Waste Management & Disposal           |
| .4 | Section 01 78 30 | Closeout Submittals                   |
| .5 | Section 23 05 00 | Common Work Results – Mechanical      |

### **1.2 System Description**

- .1 Performance Requirements:
  - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

### **1.3 Submittals**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples. Include product characteristics, performance criteria, and limitations.
  - .2 Indicate following:
    - .1 Capacity.
    - .2 Throw and terminal velocity.
    - .3 Noise criteria.
    - .4 Pressure drop.
    - .5 Neck velocity.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.

### **1.4 Quality Assurance**

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

### **1.5 Delivery, Storage and Handling**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Section 01 61 10 - Product Requirements.

- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management & Disposal.

## **1.6 Maintenance**

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Section 01 78 30 - Closeout Submittals.
  - .2 Include:
    - .1 Keys for volume control adjustment.
    - .2 Keys for air flow pattern adjustment.

## **2 PRODUCTS**

### **2.1 General**

- .1 Size as indicated.
- .2 Capacity, pressure drop, terminal velocity, throw, noise level, neck velocity shall conform to intended performances of specified materials.
- .3 Frames:
  - .1 Full perimeter gaskets.
  - .2 Plaster frames where set into plaster or gypsum board and as specified on architectural reflected ceiling plans.
  - .3 Concealed fasteners.
- .4 Where balancing damper is scheduled, damper shall be of opposed blade type.
- .5 Diffusers, grilles and registers in areas with high humidity shall be of aluminum construction.
- .6 Provide neck transition as required.

### **2.2 Manufactured Units**

- .1 Grilles, registers and diffusers of same generic type, product of one manufacturer.

### **2.3 Return, Exhaust, and Transfer Grilles and Registers**

- .1 Exhaust grille, Type EG-1: egg crate, steel, 13 mm x 13 mm x 13 mm aluminum grid core, surface mounted. Finish: white baked enamel.

### **3 EXECUTION**

#### **3.1 Manufacturer's Instructions**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

#### **3.2 Installation**

- .1 Install in accordance with manufacturers instructions.
- .2 Install with flat head screws in countersunk holes where fastenings are visible.
- .3 Paint matte black behind all diffusers, grilles and registers so that no metallic part will be visible from the exposed side.

**END OF SECTION**



## **1 GENERAL**

### **1.1 Related Sections**

- .1 Section 01 33 00 Shop Drawings, Product Data & Samples
- .2 Section 01 35 33 Health & Safety Requirements
- .3 Section 01 74 19 Waste Management & Disposal
- .4 Section 23 05 00 Common Work Results – Mechanical

### **1.2 References**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM E 90-04, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- .3 Air Movement and Control Association (AMCA)

### **1.3 System Description**

- .1 Performance Requirements:
  - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

### **1.4 Submittals**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples. Include product characteristics, performance criteria, and limitations.
    - .1 Indicate following:
      - .1 Pressure drop.
      - .2 Face area
      - .3 Free area.
      - .4 Beginning point of water penetration.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Shop Drawings, Product Data & Samples.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
- .3 Test Reports:
  - .1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E 90.

### **1.5 Quality Assurance**

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health & Safety Requirements.

### **1.6 Delivery, Storage and Handling**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Section 01 61 10 - Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management & Disposal.

## **2. PRODUCTS**

### **2.1 Roof Ventilator Hoods**

- .1 Application: exhaust fan vent and outdoor air intake vent
- .2 General: Spun aluminum gravity roof ventilator, heavy gauge aluminum windband with rolled bead construction. Rigid galvanized steel internal components with birdscreen. Heavy-gauge aluminum curb cap with spun venturi.

### **2.2 Louvres**

- .1 Louvres shall have free areas as scheduled, be of extruded aluminum sections and have all welded assemblies. Fitted with removable aluminum 12mm (1/2") mesh, 16 gauge bird-screen on interior. Louvre flanges shall be suitable for type of construction encountered, caulked and weather-tight.

## **3 EXECUTION**

### **3.1 Manufacturer's Instructions**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.2 Installation**

- .1 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated.
- .3 Anchor securely into opening. Seal with caulking around to ensure weather tightness.

**END OF SECTION**

## 1 GENERAL

### 1.1 Summary

- .1 Section Includes:
  - .1 Materials and components for electric-resistance furnaces.
- .2 Sustainable requirements for construction and verification.
- .3 Related Requirements
  - .1 Section 01 33 00 Shop Drawings, Product Data & Samples
  - .2 Section 01 35 33 Health & Safety Requirements
  - .3 Section 01 61 10 Product Requirements
  - .4 Section 01 74 11 Cleaning
  - .5 Section 01 74 19 Waste Management & Disposal
  - .6 Section 01 78 30 Closeout Submittals
  - .7 Section 01 91 31 Commissioning (CX) Plan
  - .8 Section 23 05 13 Common Motor Requirements for HVAC Systems
  - .9 Section 23 05 48 Vibration & Seismic Controls for HVAC Piping & Equipment
  - .10 Section 23 08 00 Commissioning of Mechanical Systems
  - .11 Section 23 09 33 Electrical and Electronic Control System for Mechanical Systems

### 1.2 References

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1 ASHRAE 52.1-[92], Gravimetric and Dust Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter (ANSI approved).
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

### 1.3 Action and Informational Submittals

- .1 Product Data:
  - .1 The Owner to provide a copy of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 – Submittal Procedures.

- 2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
    - .1 Submit drawings stamped and signed by professional engineer registered or licensed in British Columbia, Canada.
  - .2 Include:
    - .1 Physical dimensions.
    - .2 Filter accessibility.
    - .3 Fan configuration.
  - .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
    - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
    - .2 Instructions: submit manufacturer's installation instructions.

#### **1.4 Quality Assurance**

- .1 Regulatory Requirements: work to be performed in compliance with CEPA, CEEA and TDGA in British Columbia.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

#### **1.5 Delivery, Storage and Handling**

- .1 Packing, shipping, handling and unloading:
- .2 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
- .3 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

## **2 PRODUCTS**

### **2.1 General**

- .1 Multipoise design for maximum versatility.
- .2 Factory-supplied power plug.

### **2.2 Quality Assurance**

- .1 All models listed with UL (US and Canada) are ARI.

### **2.3 Cabinet**

- .1 Unique cabinet design that meets new stringent regulations for air leakage. Meets requirements of a 2% cabinet leakage rate when tested at 1.0 in. of static pressure.
- .2 HUD approved for manufactured housing.
- .3 Pre-painted galvanized – steel cabinet (taupe metallic).
- .4 High-density, super thick R-4.2 insulation.
- .5 Newly-improved filter rack area – filter door insulation added for an improved air seal.

### **2.4 Electric Heating Elements**

- .1 Field-installed heater packages from 3-30 kW (fused, circuit breaker, or non-fused).

### **2.5 Blower Motor**

- .1 3-speed motors.

### **2.6 Filters**

- .1 Factory-supplied cleanable filter.
- .2 Provide two (2) spare filter sets for each furnace.

### **2.7 Controls**

- .1 Controls will include a compatible 7-day hour programmable thermostat (supplied, wired and installed by the Control Contractor).
- .2 Control board with built-in, replaceable 5-amp blade-type auto fuse.
- .3 Time-delay relay (TDR).
- .4 40-VA, 208/230v transformer.

## **3 EXECUTION**

### **3.1 Manufacturer's Instructions**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **3.2 Installation**

- .1 Locate furnace allowing accessibility for service and filter change.
- .2 Check for free rotation of fan.
- .3 Make connections to 7-day programmable thermostat in accordance with manufacturer's instructions.

### **3.3 Cleaning**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

## 1 GENERAL

### 1.1 Related Sections

.1	Section 01 11 55	General Instructions
.2	Section 01 35 33	Health and Safety Requirements
.3	Section 01 91 31	Commissioning (CX) Plan
.4	Section 01 78 30	Close-Out Submittals
.5	Section 01 74 19	Waste Management & Disposal
.6	Section 23 05 00	Common Work Results – Mechanical
.7	Section 23 05 13	Common Motor Requirements for HVAC Systems
.8	Section 23 05 48	Vibration & Seismic Controls for HVAC Piping & Equipment
.9	Section 23 08 00	Commissioning of Mechanical Systems
.10	Section 23 09 33	Electrical and Electronic Control System for Mechanical Systems

### 1.2 References

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1 ASHRAE 52.1-1992, Gravimetric and Dust Spot for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
- .2 American National Standards Institute (ANSI) / Canadian Standards Association (CSA International)
  - .1 ANSI Z21.47-2012/CSA 2.3-2012, Gas-Fired Central Furnaces.
  - .2 ANSI Z83.8-2013/CSA 2.6-2013, Gas Unit Heaters, Gas Packaged Heaters, Gas Utility Heaters and Gas-Fired Duct Furnaces.
- .3 Canadian Standards Association (CSA International) / Canadian Gas Association (CGA)
  - .1 CGA 3.2-1976(R2009), Industrial and Commercial Gas-Fired Package Furnaces.
- .4 Canadian Standards Association (CSA International)
  - .1 CAN/CSA-B149.1-10, Natural Gas and Propane Installation Code.
  - .2 CAN/CSA-B149.2-10, Propane Storage and Handling Code.
  - .3 CSA C22.2 No.24-93(R2013), Temperature-Indicating and Regulating Equipment.
- .5 Canadian Electrical Code

### 1.3 Submittals

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 11 55 – General Instructions. Include product characteristics, performance criteria, and limitations.

- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 11 55 – General Instructions.
  - .2 Indicate the following:
    - .1 Equipment, capacity, piping, and connections.
    - .2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.
  - .3 Quality assurance submittals: submit following in accordance with Section 01 11 55 – General Instructions.
    - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
    - .2 Instructions: submit manufacturer's installation instructions.
  - .4 Closeout Submittals:
    - .1 Provide maintenance data for incorporation into manual specified in Section 01 11 55 – General Instructions.

#### **1.4 Quality Assurance**

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

#### **1.5 Delivery, Storage and Handling**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Section 01 11 55 – General Instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 11 55 – General Instructions.

#### **1.6 Extra Materials**

- .1 Provide maintenance materials in accordance with Section 01 11 55 – General Instructions.
- .2 Furnish following spare parts:
  - .1 One set of spare filters.



## **2 PRODUCTS**

### **2.1 General**

- .1 Furnish a 4-way multi-poise two-stage gas-fired condensing furnace for use with propane (factor-authorized conversion kit required for propane); furnish external media cabinet for use with media filter.

### **2.2 Quality Assurance**

- .1 Unit will be designed, tested and constructed to the current ANSI Z 21.47/CSA 2.3 design standard for gas-fired central furnaces.
- .2 Unit will be third party certified by CSA to the current ANSI Z 21.47/CSA 2.3 design standard for gas-fired central furnaces. Unit will carry the CSA Blue Star® and Blue Flame® labels. Unit efficiency testing will be performed per the current DOE test procedure as listed in the Federal Register.
- .3 Unit will be certified for capacity and efficiency and listed in the latest AHRI Consumer's Directory of Certified Efficiency Ratings. Unit will carry the current Federal Trade Commission Energy Guide efficiency label.

### **2.3 Blower Wheel and ECM Blower Motor**

1. Galvanized blower wheel shall be centrifugal type, statically and dynamically balanced. Blower motor of ECM type shall be permanently lubricated with sealed ball bearings of 1 hp and have multiple speeds from 600-1200 RPM operating only when 24-VAC motor inputs are provided. Blower motor shall be direct drive and soft mounted to the blower housing to reduce vibration transmission.

### **2.4 Casing**

- .1 Casing shall be of .030 in. thickness, pre-painted steel.

### **2.5 Draft Inducer Motor**

- .1 Draft inducer motor shall be two-speed PSC design.

### **2.6 Primary Heat Exchangers**

- .1 Primary heat exchangers shall be 3-Pass corrosion-resistant aluminized steel of fold-and-crimp sectional design and applied operating under negative pressure.

### **2.7 Secondary Heat Exchangers**

- .1 Secondary heat exchangers shall be of a stainless steel flow-through of fin-and-tube design and applied operating under negative pressure.

## 2.8 Controls

- .1 Controls shall include a micro-processor-based integrated electronic control board with at least 16 service troubleshooting codes displayed via diagnostic flashing LED light on the control, a self-test feature that checks all major functions of the furnace and a replaceable automotive-type circuit protections fuse. Multiple operational settings available including low heat, high heat and a continuous fan. Continuous fan speed may be adjusted from the thermostat.
- .2 General: conform to CSA C22.2 No.24.
- .3 Gas firing:
  - .1 7-day 24-hour programmable thermostat.
  - .2 Electronic pilot ignition.
  - .3 Manual main shut-off valve, automatic safety pilot, automatic electric valve and gas pressure regulator.
  - .4 Fan operating control switch with adjustable set points and continuous operating switch.

## 2.9 Operating Characteristics

- .1 Refer to equipment schedules for performance data.

## 2.10 Combustion Chamber

- .1 Power vent: to manufacturer's standard.
- .2 Sealed-type: 100% outdoor air, to ANSI Z21.64.

## 2.11 Air Filter

- .1 Filter and filter housing to be supplied and field installed by contractor. Filter shall be 25 mm thick, glass fiber, disposable-type 30 % efficiency to ASHRAE 52.
- .2 Filter size: as indicated.
- .3 Face velocity shall not exceed 2.5 m/s [500 fpm].
- .4 Provide two (2) spare filter sets for each furnace.

## 2.12 Intake and Vent Assembly

- .1 Provide manufacturer's standard roof, combined concentric and intake complete with termination assembly as indicated for high efficiency propane condensing furnace.
- .2 Intake: PVC pipe.
- .3 Vent: CPVC pipe to ULC System 636.

## 2.13 Condensate Drain

- .1 Condensate drain trap assembly shall be mounted on either side of cabinet, outside the condition airstream.

- .2 Provide acid neutralizer utilizing calcium carbonate (limestone) as its neutralizing agent. Acid neutralizer shall be capable of handling 100 MBH input appliances.

### **3 EXECUTION**

#### **3.1 Installation**

- .1 Install in accordance with manufacturer's instructions, regulations of authorities having jurisdiction and to CSA-B149.1 and Canadian Electric Code.
- .2 Size anchor bolts to withstand seismic acceleration and velocity forces as specified in Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment.

#### **3.2 Start-up and Commissioning**

- .1 Start-up and submit written report to Engineer.
- .2 Commissioning:
  - .1 In accordance with Section 01 91 31 – Commissioning (CX) Plan, and Section 23 08 00 – Commissioning of Mechanical Systems.

#### **3.3 Cleaning**

- .1 Proceed in accordance with Section 01 11 55 – General Instructions.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Related Sections**

- .1 Section 01 11 55 General Instructions
- .2 Section 01 35 33 Health and Safety Requirements
- .3 Section 01 91 31 Commissioning (CX) Plan
- .4 Section 23 05 13 Common Motor Requirements for HVAC Equipment
- .5 Section 23 05 48 Vibration & Seismic Controls for HVAC Piping & Equipment
- .6 Section 23 08 00 Commissioning of Mechanical Systems
- .7 Section 23 09 33 Electrical and Electronic Control System for Mechanical Systems

### **1.2 References**

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1 ASHRAE 84-[1991], Method of Testing Air-to-Air Heat Exchangers (ANSI approved).
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

### **1.3 Submittals**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 11 55 – General Instructions. Include product characteristics, performance criteria, and limitations.
- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 11 55 – General Instructions.
- .3 Quality assurance submittals: submit following in accordance with Section 01 11 55 – General Instructions.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
- .4 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 11 55 – General Instructions.
- .5 Certificates:
  - .1 Catalogued or published ratings: obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards in force.
  - .2 Provide confirmation of testing.

#### **1.4 Quality Assurance**

- .1 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

#### **1.5 Delivery, Storage, and Handling**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 11 55 – General Instructions.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 11 55 – General Instructions.

#### **1.6 Maintenance**

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Section 01 11 55 – General Instructions

#### **1.7 Warranty**

- .1 Parts: 2 years non-prorated.
- .2 Heat exchanger (polypropylene) core: 15 years.

### **2 PRODUCTS**

#### **2.1 General**

- .1 Comply with ASHRAE 84.

#### **2.1 Air-to-Air Fixed Plate Exchanger**

- .1 Housing: pre-painted steel.
- .2 Insulation: expanded polystyrene.
- .3 Blowers: twin high-pressure blowers with PSC motors and permanently lubricated bearings.
- .4 Heat transfer surfaces: cross-flow, corrugated polypropylene, edge sealed and bonded to casing. Independent speed adjustment of either supply or exhaust motors in both high and low speed.
- .5 Cross contamination: not permitted.
- .6 Removable access panels.
- .7 Accessories: drain kit, core air filters - to be 30 ppi washable foam
- .8 Performance characteristics: as indicated on equipment schedules.

- .9 Defrost control and damper: integral with unit.
- .10 Controls: as specified.
- .11 Integrated balancing and backdraft dampers in exhaust to outside and fresh air supply ports.

### **3 EXECUTION**

#### **3.1 Installation**

- .1 Install units in accordance with manufacturer's instructions and as indicated.
- .2 Support independently of adjacent ductwork with flexible connections.
- .3 Ensure adequate clearance for servicing and maintenance.
- .4 Size anchor bolts to withstand seismic acceleration and velocity forces as specified in Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment.
- .5 Nothing to obstruct ready access to components or to prevent removal of components for servicing.

#### **3.2 Condensate drain.**

- .1 Install deep seal P-traps on drip lines.

#### **3.3 Start-up and Commissioning**

- .1 Start-up and submit written report to Departmental Representative.
- .2 Commissioning:
  - .1 In accordance with Section 01 91 31 – Commissioning, and Section 23 08 00 – Commissioning of Mechanical Systems.

#### **3.4 Cleaning**

- .1 Proceed in accordance with Section 01 11 55 – General Instructions.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

#### **3.5 Controls**

- .1 Controls will include wall mounted CO<sub>2</sub> and Humidity Sensor with 0-10 VDC output. Refer to equipment schedules, drawing notes and Section 23 09 33 Electrical and Electronic Control System for Mechanical Systems.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Related Sections**

- .1 Section 01 11 55 General Instructions
- .2 Section 01 35 33 Health and Safety Requirements
- .3 Section 01 91 00 Commissioning
- .4 Section 23 05 00 Common Work Results – Mechanical
- .5 Section 23 08 00 Commissioning of Mechanical Systems

### **1.2 References**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 Air Conditioning & Refrigeration Institute (ARI)
  - .1 ARI 410-2001, Forced-Circulation Air-Cooling and Air-Heating Coils.
- .3 Federal Halocarbon Regulations, 2003.

### **1.3 Submittals**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 – General Instructions. Include product characteristics, performance criteria, and limitations.
- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 11 55 – General Instructions.
  - .2 Indicate the following:
    - .1 Equipment, capacity, piping, and connections.
- .3 Quality assurance submittals: submit following in accordance with Section 01 11 55 – General Instructions.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
- .4 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 11 55 – General Instructions.
  - .2 Provide halocarbons documentations in accordance with Section 23 05 00 – Common Works Results – Mechanical.

#### **1.4 Quality Assurance**

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

#### **1.5 Delivery, Storage and Handling**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Section 01 11 55 - General Instructions Requirements.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 11 55 – General Instructions.

### **2 PRODUCTS**

#### **2.1 General**

- .1 General: air coil certified by ARI 410.
- .2 Applications: hydronic, direct expansion (DX), or steam as scheduled.
- .3 Capacity, pressure drop, dimensions as scheduled.
- .4 Maximum air velocity:
  - .1 Heating: 3.0 m/s (600 FPM).
- .5 Maximum operating pressure:
  - .1 Hydronic: 1,724 kPa (250 psi)
- .6 Factory tested at 2,172 kPa (315 psi) air pressure under water.

#### **2.2 Construction**

- .1 Tube: NPS 5/8 O.D., 0.51mm (0.02”) thick seamless copper with 0.64 (0.025”) thick bends. Water velocity selected at less than 1.2 m/s (4 ft/s).
- .2 Fins: 0.2mm (0.008”) thick aluminum, mechanically bonded to tubes. Fin spacing shall not exceed 14 fins per inch.
- .3 Header: seamless copper with die formed collars for brazing coil tubes, vent and drain connection.
- .4 Casing: minimum 1.6mm (16 gauge) channel construction with flanges punched for mounted. Galvanized steel for heating coils and type 304 stainless steel for cooling coils. Provide intermediate tube support at 1,200mm (48”) interval.
- .5 Connections: red brass, MPT connections.
- .6 Hydronic and DX coils shall have connections on the same side of header.



### **3 EXECUTION**

#### **3.1 Manufacturer's Instructions**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

#### **3.2 Installation**

- .1 Install in accordance with manufacturer's instructions.
- .2 Install in accordance with piping layout.
- .3 Arrange coils for counter-flow of air and fluid.
- .4 Provide space for cleaning, servicing or removal of all coils.
- .5 For hydronic coils with vertical headers, arrange water entry at bottom to facilitate air removal.
- .6 Clean finned tubes and comb straight.
- .7 Provide unions at coil connections.
- .8 Provide dielectric fittings at dissimilar metal.
- .9 Clean finned tubes and comb straight.

#### **3.3 Start-up and Commissioning**

- .1 Conduct start-up and submit written report to Departmental Representative.
- .2 Commissioning:
  - .1 In accordance with Section 01 91 00 – Commissioning, and Section 23 08 00 – Commissioning of Mechanical Systems.
- .3 Halocarbons Management:
  - .1 In accordance with Section 23 05 00 – Common Works Results – Mechanical.

#### **3.4 Cleaning**

- .1 Proceed in accordance with Section 01 11 55 – General Instructions.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Related Sections**

- |    |                  |                                     |
|----|------------------|-------------------------------------|
| .1 | Section 01 11 55 | General Instructions                |
| .2 | Section 01 91 00 | Commissioning                       |
| .3 | Section 23 05 00 | Common Work Results - Mechanical    |
| .4 | Section 23 08 00 | Commissioning of Mechanical Systems |

### **1.2 General**

- .1 Provide, install, program and commission a BACnet-based DDC controls system to achieve the performance specified in the following clauses.
- .2 Work covered by sections referred to above consist of fully operational EMCS, including, but not limited to, following:
  - .1 Building Controllers.
  - .2 Control devices as listed in I/O Summaries.
  - .3 Data communications equipment necessary to effect an EMCS data transmission system including gateway and LAN hardware and software for connection to BACnet network.
  - .4 Field control devices.
  - .5 Software and graphics upgrade complete with full documentation for software and equipment.
  - .6 Complete operating and maintenance manuals and field training of operators, programmers and maintenance personnel.
  - .7 Acceptance tests, technical support during commissioning, full documentation.
  - .8 Wiring interface co-ordination of equipment supplied by others.
  - .9 Miscellaneous work as specified in these sections and as indicated.
  - .10 Firestopping for new penetrations through existing fire rated assemblies. Refer to Section 23 05 00 – Common Work Results – Mechanical

### **1.3 Metric Reference**

- .1 Conform to CAN/CSA-Z234.1.
- .2 Provide required adapters between Metric and Imperial components.

### **1.4 Standard Compliance**

- .1 All equipment and material to be from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
- .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
- .3 Submit proof of compliance to specified standards with shop drawings and product data. Label or listing of specified organization is acceptable evidence.

- .4 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.
- .5 For materials whose compliance with organizational standards/codes/specifications is not regulated by an organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

### **1.5 Existing Control Components**

- .1 Utilize any existing control wiring and/or piping as indicated.
- .2 Field control devices that are usable in their original configuration may be re-used provided that they conform to applicable codes, standards, specifications. Do not modify original design of any existing devices without written permission from the Departmental Representative. Provide for new, properly designed device where components are not certain as to reusability. Provide list of equipment so included in bid. Include unit price of all for this equipment.
- .3 Within 30 days of award of contract, and prior to installation of any new devices, inspect and test all existing devices intended for re-use. Furnish test report listing each component to be re-used and indicating whether it is in good order or requires repair by Departmental Representative.
- .4 Non-functioning items:
  - .1 Provide with report specification sheets or written functional requirements to support findings.
  - .2 Departmental Representative will provide directions related to repair or replacement existing items judged defective yet deemed necessary for EMCS.
- .5 Submit written request for permission to disconnect any controls and to obtain equipment downtime before proceeding with work.
- .6 Assume responsibility for existing controls to be incorporated into EMCS, to commence upon approval for disconnection of controls or equipment downtime.
  - .1 Be responsible for repair costs due to negligence or abuse of Departmental Representative's equipment.
  - .2 Responsibility for existing devices to terminate upon acceptance of EMCS or applicable portions thereof.
- .7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

### **1.6 Submittals**

- .1 Submit in accordance with Section 01 11 55 – General Instructions.
- .2 Provide six copies of schematic control diagrams for review. Each valve, actuator and instrument shall be given an identification label which will refer directly to control diagram.
- .3 Provide damper shop drawings which include data such as arrangement, velocities, and static pressure drops for each system on shop drawings.

- .4 Provide shop drawings including complete operating data, system drawings, wiring diagrams, and type written detailed operational description of sequences, and description and engineering data on each control system component.
- .5 At completion of work, make detailed check of automatic control system and submit written report to the Departmental Representative.
- .6 Provide sufficient copies of complete parts and repair manuals for binding in O&M Manuals.
- .7 Provide "record" control drawings and schedules; incorporate into O&M Manuals.
- .8 The submittals shall be prepared using the dynamic graphics software normally provided with system and be incorporated into the dynamic graphics system for on-line reference. Provide original, registered software disks of Windows, the Graphics Software package, the Operating System software, and the project graphic schematics, floor plan layouts, and control drawings.

### **1.7 Extra Materials**

- .1 Provide maintenance materials in accordance with Section 01 11 55 – General Instructions.

### **1.8 Preliminary Design Review Meeting**

- .1 Convene a Preliminary Design Review meeting within 45 working days of award of contract to:
  - .1 Undertake functional review of preliminary design documents, resolve inconsistencies.
  - .2 Resolve conflicts between contract document requirements and actual items (e.g.: points list inconsistencies).
  - .3 Review interface requirements of materials supplied by others.
  - .4 Review "Sequence of Operations".
- .2 Contractor's programmer to attend meeting.
- .3 Departmental Representative retains right to revise sequence or subsequent Control Description Logic prior to software finalization without cost to Departmental Representative and Owner.

### **1.9 Monitoring and Control Features**

- .1 Operator defined digital and analogue alarms and automatic alarm condition reporting.
- .2 Direct keyboard override of all inputs and outputs, with an indication on the display for any point that is operating under keyboard override.
- .3 Addition, deletion, definition and modification of all points from operator keyboard.
- .4 Trend log graphing and reporting of user selected points at user defined intervals.
- .5 Run time logging of digital points.
- .6 Ability to accept a variety of standard analogue and digital input signals.
- .7 Ability to generate a variety of standard analogue and digital output signals.

### **1.10 Offline Storage**

- .1 The DDC system shall have the capability to be taken off-line in the event of failure or for maintenance and returned to operation without the need for entering any portion of the software program manually.
- .2 An off-line disk storage device shall be utilized to provide software backup and reload. Backup and verification of the entire system, with full applications software, shall be less than TWO (2) seconds per real point.

### **1.11 Power Surge Protection**

- .1 The DDC system shall be protected from power line surges and voltage transients by installation of a power line filter.

### **1.12 Power Failure Protection**

- .1 The DDC system shall have automatic protection from any power failure of at least TWENTY-FOUR (24) hours duration.
- .2 This protection shall at a minimum include continuous real-time clock operation and automatic system restart upon power return.
- .3 Outputs shall have the option of being set to “staggered start” upon power reset.

### **1.13 Electrical Components, and Conduit**

- .1 Provide all control system components, except those supplied as part of packaged equipment controls, but including all auto sequencing devices, electric relays, safety devices and electrical interlocks required to accomplish specified sequences. Refer to the electrical motor schedule in the electrical drawings and/or specification, which delineate the limits of electrical work in Division 26 (Electrical) serving mechanical systems.
- .2 Provide all control circuit transformers required for control systems and not supplied by Division 26 including line voltage power connection from indicated outlets shall be included by Division 25.
- .3 All line voltage wiring shall be copper with RW90 X-Link P.E. insulation #12 minimum size. AWG wire shall be sized to meet code.
- .4 All wiring installed under this contract shall be plenum rated FT-6, or FT-4 if installed in conduits. Locate wiring away from top or bottom of ceiling joists or trusses to minimize possibility of accidental damage. Number 18 gauge wire may be used in Class 2 circuits unless voltage drops are excessive. THHN wire will not be acceptable. Twisted shielded wiring, minimum of 22 gauge wire shall be used for all DDC or co-axial communication wiring. Line voltage alternating current wiring shall not be run in the same conduit, or cabling as DDC wiring.
- .5 Use 1m of flexible conduit for all connections to vibrating equipment. Use liquid tight flex cable and connections where required.
- .6 The Control Contractor shall locate magnetic starters from the electrical drawings. All electrical work provided by this Contractor shall comply with all requirements of the Division 26 electrical specification, the Canadian Electrical Code and Local Codes and Ordinances.
- .7 Wire all line voltage thermostats, pressure switches or aquastats for single phase equipment.

- .8 Division 26 has been requested to provide specific devices, including magnetic starters supplied with 120 volt holding coils, HOA switching and space for the addition of auxiliary contacts. The Control Contractor shall provide all necessary normally open and normally closed contacts, wired to a terminal strip within the starter enclosure, required to achieve the specified control interlocking and sequencing. Manual starters for 120 volt equipment are to contain On-Off selector, external H.O.A., integral overload protection and pilot lights. The Controls Contractor shall provide control wiring interlocks from the control contacts provided on the automatic branch lines of the assembly, which will be contained within the associated Motor Control or Starter Assembly.
- .9 Refer to Division 26 Specifications and Motor Schedule for the scope of work to be provided by the Electrical Contractor. Division 25 shall supply and install all components, in addition to those outlined within the Division 26 documents, as may be deemed necessary to provide all interlocks or sequences as called for elsewhere within the specifications. Include for the supply and installation of 2- 4 pair U.T.P. Level 5, plenum rated cables from the hub location to the communications backboard. Coordinate with Division 26 and the Owner for interconnection of the hub into the Telephone System services.
- .10 All power supplies for controls are this Contractor's responsibility unless otherwise specified in the Electrical Specifications. All control transformers to be located in fan rooms or mechanical rooms only and are to be mounted in serviceable locations.
- .18 Retain all existing fire alarm / smoke detectors interlocks with air handling equipment. **Contractor must arrange and pay for all costs associated with fire alarm verification (including costs incurred by Departmental Representative) if any work is done to the existing fire alarm / smoke detectors interlocks.**
- .11 Line voltage will not be run with signal or trunk wiring or be present in the same junction box.
- .12 All shielded wiring will be grounded at the BMS panels and prevented from grounding at the terminal end.
- .13 Run all wiring parallel to building lines. All wiring to be installed in a neat, workmanlike manner.
- .14 Support wiring independent of piping, ductwork, and equipment. Keep wiring clear of hot piping, ductwork/equipment.
- .15 Identify all junction boxes with control company label.
- .16 There are to be no splices in any of the control wiring except at devices or control panels.
- .17 LAN wiring shall be CAT5E UTP to TIA/EIA-568.
- .18 Retain all existing fire alarm / smoke detectors interlocks with air handling equipment. **Contractor must arrange and pay for all costs associated with fire alarm verification (including costs incurred by Departmental Representative) if any work is done to the existing fire alarm / smoke detectors interlocks.**

#### 1.14 Identification, Calibration and Programming

- .1 Provide a written sequence of operation for each piece of equipment or system being controlled that does not require knowledge of DDC programming. Provide a print out of the complete data base, including program listings, inputs, outputs, controllers, virtual

points, trend logs, alarm points, etc. Provide in an organized manner, separated for each panel.

- .1 Procedures for daily operation of the system.
- .2 Theory of operation of the equipment.
- .3 Theory of operation of the control program.
- .2 Mount an input/output layout sheet within each controller. This sheet shall include the name of the points connected to each controller channel.
- .3 Identify all controllers and associated devices with symbols relating directly to the control diagram. Provide plastic labels for each input and output point with the following information:
  - .1 Point descriptor.
  - .2 Point type and channel number.
  - .3 Corresponding controller number.
- .4 Program each controller immediately following installation. Setup and tune all control loops during the initial startup of the systems. Submit a well documented print out of the controller program for review.
- .5 At the time of the Owner's Demonstration and Instruction Period:
  - .1 Demonstrate and confirm that all systems are programmed and operating correctly. Submit trend logs, 1 week in duration, that confirm systems are operating as designed and follow the internal building loads in an energy efficient manner.
  - .2 Submit CD's (including back-up diskettes) containing up to date copies of the programs in each controller.
  - .3 Submit (4) CD's with printed PDF copies of the final programs that include all point definitions, weekly and annual schedule settings, controller set points and tuning parameters, and documented general control language programs. (As Built control shop drawings)
  - .4 Provide the original software diskettes and the users manuals for all software programs provided as part of this contract. Provide one set of original disks for each notebook, laptop, and desktop computer the software has been installed on. The controls contractor shall be responsible for registering all software with the manufacturer in the owner's name. Provide copies of the registration of all software to the Departmental Representative as part of the final inspection.
- .6 Check sensor calibration and control system operation twice during the first year of operation including the first heating season and prior to the first cooling season. Include all parts and labour in service. Following each visit submit:
  - .1 A report indicating all work performed.
  - .2 Printed graphs of trend logs one week in duration with hourly samples for all analog inputs connected to each controller.
  - .3 Update printed and diskette copies of any changes made to programs for any controller.

- .7 Provide one day of on-site instruction to the Owner's operating personnel during the first year of operation, scheduled as requested by the Owner, during one or more of the 2 visits.

### **1.15 Controller Software**

- .1 Each stand alone control panel shall contain a complete software development system in each panel. The software development system shall consist of a menu driven, prompted programming language containing complete libraries of control algorithms for DDC, Energy Management, and Facilities Management functions. These resident libraries of algorithms shall be drawn from for the creation of the application specific programming of each individual stand alone control panel.
- .2 Four user access levels shall be provided with a user access code available at each level. Each level shall permit identifiable multiple user access.
- .3 Point names shall be defined using a minimum of 128 alphanumeric characters to provide an English language description of the point function.
- .4 The stand alone control panel shall be capable of generating sorted alarm, trend log, energy management, maintenance time remainder, and exception log reports on a prioritized basis. Segregated report generation shall be invoked by manual request, time of day, calendar, accumulated run time, or event occurrence.
- .5 DDC Control:
  - .1 The network of standalone control panels shall individually perform set point reset, ramping functions, 2-position ON/OFF control, PID loop control, linear sequencing, rotating sequencing, binary sequencing, HI/LO/AVE selection, energy dead band, and thermostat controls as required to control their connected systems of equipment.
- .6 Energy Management Control:
  - .1 The network of standalone control panels shall individually perform time of day scheduling, optimum start/stop, enthalpy optimization, trend logging, demand limiting and all control optimization strategies, such as supply air reset, and soft ramp-up, for their connected systems of equipment.
  - .2 Coordination of strategies involving multiple systems of equipment shall be performed by sharing of necessary data between the stand-alone control panels on the communicating network.
- .7 Facilities Management Control:
  - .1 The Owner shall be provided the ability to read out temperatures and other values and to adjust specific items from localized, as well as remote centralized location. Every controller shall provide the following reports:
    - .2 Facility Diagnostics
      - .1 The facilities management system shall provide diagnostic reports for selected systems of equipment as specified.
    - .3 Alarm Occurrence Status
      - .1 When specified alarm conditions occur, provide a report available to printout, listing the status of specific items associated with the equipment generating the alarm. Report shall be routed through auto dial out feature to a specific printer or combination of printers. Report shall record the



time the status information was taken, and shall allow operational personnel to use this information to diagnose the alarm situation.

- .8 SAC and Micro Controller Trend Logs:
  - .1 Controllers shall be capable of storing up to twenty-five (25) full trend logs with a minimum of 200 data samples each. They shall be able to collect and store samples of the value of any system variable (i.e. temperature). The operator shall be able to create a trend log, with each trend log containing up to 4 points. The sample frequency shall be selectable for each trend log between 1 second and 24 hours. The ability to graphically display to 4 points on the screen simultaneously, print a log, or store a log on disk in an ASCII format that can be imported into a standard spreadsheet program shall be provided. This capability shall be provided for all forms of access.
- .9 Network communication/controllers Trend Logs:
  - .1 Trend logs shall be provided to collect and store samples of the value of a point i.e., temperature. The network communication/controllers shall have sufficient memory to create and store 200 full trendlogs. Each BacNet trendlog shall be capable of monitoring 1 I/O or virtual point from any controller or combination of controllers across the network, and storing a minimum of 2000 data samples for each trended point. The sample frequency shall be selectable for each trend log between 1 second and 24 hours. The network communication/controllers shall be capable of archiving the trended data to the Host computer or dialing out to a remote trend computer and downloading the data automatically. The ability to indefinitely retain the contents of a trend log in the controller or automatically transfer the contents of a trend log to disk storage, printer or remote site and restart the log shall be provided.
- .11 Host Level Trending:
  - .1 Shall be provided to collect and store samples of the value of any system variable (i.e. temperature Trend Logs: Shall be provided to collect and store samples of the value of any system variable. The operator shall be able to create a BACnet trend log, with each trend log containing 1 point. The sample frequency shall be selectable for each trend log between 1 second and 99 hours. The ability to link multiple single point BACnet trend logs to be displayed on a 8 point Multi-trend log for comparative analysis shall be provided. Ability to print a log, or store a log on disk in an ASCII format that can be imported into a standard spreadsheet program shall be provided. This capability shall be provided for all forms of access.
- .12 The Ethernet interface with the remote operator's terminal shall provide all features listed above.

## **1.16 Computer Graphics Software**

- .1 Incorporate the following standards for the required host capabilities and installed features:
  - .1 The host computer operator interface, network interface and graphical interface software shall be Microsoft Windows based.

- .2 Provide one licensed copy of the complete HOST software package complete with operating manuals, installation manuals, setup manuals, programming manuals, and original diskettes.
  - .3 Host operator interface.
- .2 The following functionality shall be available to the operator from either the onsite host, remote host, or colour laptop connected to anywhere on the network inside the building. These workstations shall operate as graphic interface devices. Attention must be paid to developing an interface to the system using a minimum of user keystrokes. The primary user interface must be the mouse.
- Provide functionality such that any of the following may be performed simultaneously, at either workstation and in any combination, via user-sized windows.
- .1 Dynamic color graphics and graphic control
  - .2 Alarm management and control
  - .3 Time of day scheduling
  - .4 Trend data definition and presentation
  - .5 Graphic definition
  - .6 Graphic construction
  - .7 Database functions
- .3 Graphic generation and design:
- .1 Provide a default graphic consisting of a visual overview of the entire control system. The display shall be in a tree format. Indicate the various branches of graphic access available from the tree for each mechanical system and building zone. The site plan of the facility should be used as a reference tree to show the relationship of each system to a particular building zone. Graphic links for each zone must be available to allow the user to link directly to the desired graphic or step systematically forward or backward through the tree to each graphic associated with the mechanical system. The operator must be able to return directly to the default from any level of graphic menu penetration.
  - .2 As a minimum, provide the following graphic screens and dynamic linking:
    - .1 A default graphic to be used as a central starting point for penetrating the menu of available graphic screens.
    - .2 Zone summary graphic. Dynamically indicate zone high select (Hsel) and low select (Lsel) temperatures, AHU supply air temperatures and setpoints, and status of the air handling units serving the zone.
    - .3 Dynamic graphic floor plans for each building zone, scaled appropriately to be readable from a laptop. Indicate room temperatures, architectural room number, control valve position, supply fan system serving the area, and any associated equipment such as exhaust fans, fume hoods, etc. From this screen the operator shall be able to command the control valve, adjust the room setpoint and access the graphic screen for the supply fan system, view a trend log of the room temperature, or access a graphic for associated mechanical equipment.

- .4 A schematic of each mechanical system. As a minimum, each graphic will indicate all DDC I/O points and software variables associated with each system. Indicate the DDC point names, current status value, and operator priority.

All graphic screens shall be created using the same software supplied to the owner. Provide the graphic data files in a format suitable for inclusion into the graphical operator interface and for direct loading into the graphic editor. The graphic data files shall be the sole property of the Owner.

<b>DEFAULT GRAPHIC COLOURS</b>			
Normal On	GREEN	Text Arial 12 pt	BLACK
Heating Equipment	RED	Normal Off	BLACK
Background	WHITE	Cooling Equipment	BLUE
Ducts	BLACK	<b>ALARM</b>	<b>RED</b>
Sensors	BLUE		

- .3 Graphical links:
  - .1 All system graphical links will be located in the upper left corner of the screen. These links will be displayed in sequential order representative of the menu tree.
- .4 Graphics shall be reviewed and approved by Departmental Representative prior to implementation.

**1.17 Related Work**

- .1 The following incidental work shall be furnished by the mechanical sub-contractor under the supervision of the controls subcontractor:
  - .1 Installation of control dampers including duct transitions, assembly and interconnection of multiple section dampers.
  - .2 Supply and installation of sheet metal baffles as required to eliminate air stratification.
  - .3 Supply and installation of access panels for service and installation of control equipment.
  - .4 Installation of automatic valves, wells, flow switches, and other pipe related control devices.

**2 PRODUCTS**

**Not Used**

### **3 EXECUTION**

#### **3.1 General**

- .1 Check and verify location of thermostats and other exposed control sensors with plans and room details before installation. Locate thermostats and temperature sensors 1.5m above floor. For existing installations, locate thermostats and temperature sensors at same locations as existing but not less than 1.5m above floor.
- .2 Install damper motors on outside of ducts. Do not locate in outside air stream.
- .3 The installation shall conform to each manufacturer's recommended procedures and to all applicable codes, statutes and ordinances.
- .4 All equipment installed shall be mechanically stable and, as necessary, fixed to wall or floor. Anti-vibration mounts to be provided, if required, for the proper isolation of the equipment.
- .5 Equipment shall be installed so as to allow for easy maintenance access. Equipment shall be installed such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.
- .6 Equipment shall be installed in locations providing adequate ambient conditions for its specified functioning, allowing for adequate ventilation.
- .7 Permanently identify each wire, cable, conduit and tube at each terminal.
- .8 Wiring and tubing shall be identified at each DDC panel by termination number. Wiring and tubing shall be identified at terminal device by termination and DDC panel numbers.
- .9 All transmitters, interfaces, terminations and control relays, etc. shall be mounted in field cabinets that may be locked.
- .10 Freeze protection devices shall be hard wired and also wired to alarm through DDC system.
- .11 All wall mounted devices in new finished space shall be mounted on a wall box. The wall box shall be connected to the ceiling space by a conduit stub. On renovations, when sensors are mounted in existing finished walls, wiring or tubing may be fished into the walls without conduit.
- .12 Provide tamperproof screws to new and relocated equipment, controls enclosures and devices which are located in inmate accessible areas. Tamperproof screws shall be stainless TORX with pin.
- .13 Piping wells shall be installed with heat conductive compound. Well material shall be of a material suitable for the sensed medium without undue corrosion or breakdown. All wells shall be screwed and shall be installed in such a manner to allow the sensing element to be truly indicative of the medium temperature.

#### **3.2 Enclosure and Conduit**

- .1 Relays, transformers, and I/O devices and peripherals shall be installed in separate enclosures and not in the enclosures containing the controllers.
- .2 All wires penetrating the enclosure that are not required to be in conduit must be neatly bundled and strapped in place.

- .3 All Building Controllers will be installed in CSA rated enclosures that are complete with hinged and key-locked doors. The door will be painted and labeled suitably bearing the manufacturer's system name/logos, the controller address, and the installing contractor's contact information. This enclosure will be mounted at a height that provides easy access without the need of a ladder.
- .4 A hard points list shall be affixed on the inside of the door/cover of the enclosure.
- .5 The inside bottom of the enclosure shall be clean of dirt, metal shavings, and debris.
- .6 Wiring is to be in EMT conduit with set screw metal fittings in all wall spaces and exposed locations as well as in pipe chases, service spaces, attics, and crawl spaces which are entered for service access. Wiring in suspended ceiling spaces does not require conduit but shall be neatly installed parallel to building lines using bridle rings. All conduits shall be piped smoothly and neatly following building lines. Wiring above existing ceilings and wall cavities may be run free-air.
- .7 Exposed conduits located in areas where inmates have access (see Section 23 05 00 - Common Works Results - Mechanical, Clause 3.8 Table 1) shall comply with the following security measures:
  - .1 Use two-hole straps.
  - .2 Install straps within 100mm of device boxes.
  - .3 Install straps within 100mm of both sides of fittings.
  - .4 Install straps at a maximum spacing of 500mm.
  - .5 All fittings steel.
  - .6 Keep conduit close to the wall and avoid spaces behind the conduit.
  - .7 Route conduit along top of walls where possible.
- .8 Liquid-tight flexible conduit to be used for rooftop unit wiring c/w liquid-tight fittings. Provide spun aluminum roof jack where control wiring penetrates roof unless penetration is within waterproof rooftop unit curb.
- .9 All junction boxes will have covers properly and firmly affixed after installation completion.
- .10 Control panels located in occupied areas for relays or other similar field devices shall be accessible and located above corridor ceilings. For areas accessible by inmates, provide security type access panels. Refer to Section 23 05 00 – Common Work Results – Mechanical.
- .11 Prior to start of construction, submit proposed locations of control panels to Departmental Representative for review and approval.

### **3.3 I/O Wiring**

- .1 All input/output device wiring will use #18-2 solid core cable with individually jacketed conductors and jacketed sheath over the pair.
- .2 Use plenum cable where required.
- .3 All I/O wiring passing near or within the enclosure of a VFD will be shielded, with the shield terminated at the device end.

- .4 All I/O wiring will be identified using Panduit adhesive wire-marker at the controller and end device ends. Description of point to include point mnemonic, point type and network location.
- .5 All I/O wiring within controller enclosure shall be neat and tidy and suitably bundled and strapped or contained in plastic wire duct or equivalent.
- .6 All I/O wiring that requires a transition to a different conductor to meet electrical code requirement shall be executed using a terminal strip.
- .7 Low voltage I/O wiring may be mixed together within a conduit. Low and line voltages may not be mixed together within a conduit.

### **3.4 Power Wiring**

- .1 Provide power wiring and transformers and grounding to each controller and transducer as per the manufacturer's specification.
- .2 Each Building Controller will have its own dedicated power supply. No other controller or I/O device will be powered from this supply.
- .3 Power wiring shall not be mixed with I/O wiring in a conduit.

### **3.5 LAN Wiring**

- .1 Provide LAN wiring as per manufacturer's specification.
- .2 Provide patch panel for terminating optical fibre wiring. Provide optical fibre patch cables between patch panel and Media Converters and/or Fibre Ethernet Switches.

### **3.6 Control System Commissioning**

- .1 Upon completion of the installation of the controls system and the calibration of all sensors, this Subcontractor shall carry out all required testing, debugging, and revision of operations to suit the intent of the Sequence of Operation and to the review of the Departmental Representative.
- .2 The contractor is to supply digital point and non digital checkout data sheets for all controlled components installed in this contract, including components supplied by others. The data sheets shall indicate each components physical installation is complete, End to End, identification, tagged, the result of the functional test, calibration deviation recorded, set points and set-up of each device, digital and non digital.
- .3 Each digital input or control device shall be checked by physical operation of the monitored device in the field with the result noted. Each digital output or controlled device shall be commanded or tested On/Off, Open/Close as required and the corresponding field device checked for correct operation with the result and comments noted.
- .4 Each analog input or control device shall have its field values measured with a calibrated test instrument, with the deviation recorded and adjusted, if necessary, at the AI set up. The field measurement and analog point deviation must be reported. A hard copy of the set up for each digital and non digital controller with adjustments is required. Field set up and set points of other devices shall be reported.
- .5 Each analog output, control or controlled device shall be field tested. The physical test data sheet is to indicate each controlled device function through its range 0, 25, 50, 75, 100% and 1 to 100% as required with no leakage or bypass of the controlled medium.

- .6 Submit copies of all test data sheets intended to be used to the Departmental Representative and Commissioning Authority prior to the contractor's verification at least three months before the scheduled substantial completion of the project.
- .7 The controls contractor shall provide sequence of operation check sheets, to the Departmental Representative, Commissioning Agent and Commissioning Authority, in standard letter size for each DDC and non DDC system sequence. Each sequence to be verified with each item/page signed off with comments noted.
- .8 The commissioning contractor is not to commence controls checks until the above documentation is received. The Temperature Control Supplier and Installer shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent. The software/devices shall be returned to the Control Supplier in good working order at the completion of the commissioning process, or the Commissioning Agent must reimburse the Temperature Control Supplier for the purchase price of the material.
- .9 All documentation, tagging, identification, as-builts, software, instruction manuals, special control connection to access all devices and panels must be in place before the granting of substantial performance.
- .10 The Controls Contractor shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent. The software/devices shall be returned to the Controls Contractor in good working order at the completion of the commissioning process, or the Commissioning Agent must reimburse the Controls Contractor for the purchase price of the material. The Temperature Control Supplier shall cooperate fully with the Commissioning Agent to work together to obtain a fully operating system, providing additional technicians and trades people to assist the designated commissioning person as required. Refer to Section 01 91 00 – Commissioning.
- .11 The controls contractor is to provide the technicians for field checks, calibration, checkouts, and commissioning necessary for a complete and fully operational system. Provide two 2-way portable radios for the commissioning period.

### **3.7 Third Party BACnet Integration**

- .1 Where third party systems are installed with a BACnet compatible control panel, it is the responsibility of this contractor to integrate the system into the DDC control system.
- .2 The contractor shall map over BACnet points that made available in the third party panels and provide control for ALL BACnet points permitted by the third party panels. The number of points to be allowed for shall be as follows:
  - .1 Variable speed drives – 10 points each
  - .2 Electrical main power meter – 20 points each
  - .3 Electrical sub power meters – all Modbus points, refer to Division 26 specifications
- .3 Integrate the third party system into the DDC sequence of operation. This includes scheduling, outdoor conditions (temperature and ambient lighting levels), alarms, and any other information required to operate, diagnose, and maintain the equipment.
- .4 Provide a detailed graphical display(s) depicting the third party equipment. The graphical display(s) shall contain ALL points that were mapped over from the third party system.

**3.9 Cleaning**

- .1 Proceed in accordance with Section 01 11 55 – General Instructions.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**



## **1 GENERAL**

### **1.1 Related Sections**

- .1 Section 01 11 55 General Instructions
- .2 Section 25 05 01 EMCS: General Requirements

### **1.2 References**

- .1 Canadian Standards Association (CSA)
  - .1 C22.2 No.205-12, Signal Equipment.
- .2 Institute of Electrical and Electronics Engineers
  - .1 IEEE C37.90.1-2002, Standard Surge Withstand Capabilities (SWC) Test for Protective Relays and Relays Systems.

### **1.3 Maintenance Procedures**

- .1 Provide manufacturers recommended maintenance procedures for insertion in Section 01 11 55 – General Instructions, and 25 05 01 – EMCS: General Requirements.

### **1.4 Submittals**

- .1 In accordance with Section 01 11 55 – General Instructions, and Section 25 05 01 – EMCS: General Requirements. Submit product data sheets for each product item proposed for this project.

## **2 PRODUCTS**

### **2.1 System Descriptions**

- .1 Provide a fully networked system of controllers which use LAN communications to support the distributed control features as specified herein. Each controller shall be connected directly to the LAN. Each controller shall have equal LAN access priority and shall NOT REQUIRE A SEPARATE GATEWAY or interface controller to accomplish normal, network communications.
- .2 Provide a means to ensure communication integrity. At a minimum indicate for each controller in system: on-line/off-line status, residence of program or no program, the scan rate (frequency at which the controller updates all I/O and runs all programs), the number of network points imported and exported.
- .3 The system will display an error message, in the event of a communication error.
- .4 To prevent damage to the system, each connection to the LAN shall be provided with a means of isolation, either optically or fast-blow fuse or by some other means.
- .5 Upon failure of the LAN to communicate information, each controller will retain the last legitimate value of its imported network points, and continue to control the systems based on those values. Failure of any controller, or any part of a controller on the LAN, shall not affect the ability of the LAN to communicate among the remaining controllers.

- .6 Each hard point and soft point shall have a user-definable, unique, system-wide logical point mnemonic. The format of the point mnemonic shall conform to the naming convention of the incumbent system.

## **2.2 Memory**

- .1 Each controller shall have enough random access memory for all of the following:
  - .1 Variables - ONE (1) for each hard point connected to the controller.
  - .2 PID Controllers - TWO (2) for each analogue output point connected to the controller.
  - .3 Weekly Schedules - ONE (1) for every major system connected to the controller.
  - .4 Annual Schedule - ONE (1) for the entire LAN.
  - .5 Trend Logs - ONE (1) for each pair of hard points connected to the controller with 100 samples each.
  - .6 Runtime Logs - ONE (1) for each digital hard and soft point.
  - .7 Programs - ONE (1) for each output point connected to the controller. Each program must contain enough memory for TWENTY (20) syntactically correct lines of OCL with at least four operators.

## **2.3 Processing Speed**

- .1 Scan Rate - The maximum permissible scan rate is ONE (1) second. The scan rate is defined as the time it takes to controller CPU to sample all inputs, calculate all variables, update all timers and PID controllers, check all schedules, update all trend logs and runtime logs execute all OCL programs and assign values to all outputs.

## **2.4 Building Controllers**

- .1 Building Controllers shall reside on the main LAN or highest level of communication.
- .2 The controller shall communicate on the main LAN using either Ethernet (IEEE.802.3) with TCP/IP and/or EIA-485.
- .3 In addition to main LAN communications, the controller shall support EIA-485 subLANs, PC, modem and intelligent thermostat communications.
- .4 The controller shall have at least one port (other than the PC port) which can be configured to BACnet conformance class 3 using EIA-232 point-to-point communications for interface to other BACnet products.
- .5 The controller must be modular in design with removable I/O device terminations on separate I/O cards for ease of expansion and replacement.
- .6 Controllers will accommodate a maximum of 160 universal I/O points on board using a single address.
- .7 All I/O points must be universal (i.e. user definable as digital or analogue). Dedicated analogue/digital points will not be accepted.
- .8 All outputs must have optional HOA on board for easy override by non DDC users.

## **2.5 VAV Controller**

- .1 VAV Controller (BACnet overview): A VAV Controller is VAV terminal unit controller with integral damper actuator and on-board differential pressure based flow measurement.
  - .1 Data Sharing - Ability to provide the values of any of its BACnet objects and Ability to allow modification of some or all of its BACnet objects by another device.
  - .2 Device and Network Management - Ability to respond to information about its status.
- .2 VAV Controllers shall be used for dual duct mixing boxes and single duct air terminal units.
- .3 VAV Controllers shall communicate on the main LAN or subLAN using EIA-485 (MSTP). In addition to main or subLAN communications, the controller shall support PC and/or modem communications and intelligent thermostat communications.
- .4 Programming the controller shall be accomplished over the LAN or directly via PC and will not require the mandatory use of any other special interface hardware or a Building Controller. Firmware based programming will be accepted.
- .5 Provide 120v-24vac transformers for controls.

## **2.6 Custom Application Controllers**

- .1 An AAC (B-AAC) is a general purpose, field programmable controller capable of carrying out a variety of building automation and control tasks.
- .2 Custom Application Controllers shall communicate on the main BACnet Ethernet LAN or BACnet MSTP subLAN. In addition to main or subLAN communications, the controller shall support PC and/or modem communications.
- .3 Programming the controller shall be accomplished over the LAN or directly via PC and will not require the mandatory use of any other special interface hardware or a Building Controller.
- .4 Operator Control Language shall be fully supported with this controller. FIRMWARE BASED FUNCTIONS OR PROGRAMMING WILL NOT BE ACCEPTED.

## **2.7 Application Specific Controllers:**

- .1 ASC BACnet overview: An ASC (B-ASC) is a controller with limited resources relative to an AAC. It is intended for use in a specific application and supports limited programmability.
- .2 Application Specific Controllers shall be used for the following mechanical systems:
  - .1 VAV, Fan Coils, radiation and reheat
  - .2 Radiant heating and reheat control
- .3 Application Specific Controllers shall communicate on the main LAN or subLAN using EIA-485 (MSTP). In addition to main or subLAN communications, the controller shall support PC and/or modem communications and intelligent thermostat communications.
- .4 Programming the controller shall be accomplished over the LAN or directly via PC and will not require the mandatory use of any other special interface hardware or a Building Controller. Operator Control Language programming and editing shall be fully supported with this controller. FIRMWARE BASED FUNCTIONS WILL NOT BE ACCEPTED.

## 2.8 Stand Alone Controllers:

- .1 Stand Alone Controllers common requirements (B-BC, B-AAC) (Peer to Peer): Provide a fully distributed processing system such that each major piece of mechanical equipment is controlled by its own stand-alone controller. The DDC system shall operate independently from the Host Computer. Mount all stand alone controllers at locations where indicated on drawings. Provide an outlet port for plug in of a portable PC in each mechanical room containing stand-alone controllers.
- .2 The stand-alone digital control panel shall be 16-bit microcomputer based, providing a multi-tasking operating system for simultaneous operation and control of:
  - .1 Facility management functions
  - .2 DDC control functions
  - .3 Energy management functions
  - .4 Man-machine interface
  - .5 System communications
- .3 Analog to digital and digital to analog conversions shall have a minimum 10 bit resolution.
- .4 Panel input points shall be universal allowing each point to be defined as an analog input, or digital input.
- .5 The control panel shall contain a real time clock capable of being synchronized with other real time clocks in the network.
- .6 Control panel software shall be protected from loss due to power failure for a minimum period of 72 hours.
- .7 All sensing inputs shall be provided via the following industry standards:
  - .1 0 to 20 mA
  - .2 4 to 20 mA
  - .3 0 to 5 VDC
  - .4 0 to 10 VDC
  - .5 10k type 3 thermister resistance signals
- .8 Modulating outputs shall be fully proportional. Pulse width modulation, without analog feedback, shall not be used for analog output signals. Outputs must be capable of being scaled and produce a 0% to 100% output with a fractional PID control algorithm.
- .9 Digital outputs shall be capable of directly switching the following voltages. This contractor shall provide solid state relays that will accept this signal:
  - .1 24 VAC @ 36 VA operating
  - .2 120 VAC @ 120 VA operating

## **2.9 Field Panels**

- .1 Provide local panels of unitized cabinet type for relays/devices. Mount relays, switches, transducers and controllers with set point adjustment in cabinet and pilot lights, push buttons, and switches flush on cabinet panel face.
- .2 Fabricate panels from 3.0 mm furniture steel with baked enamel finish and removable hinged key lock door.
- .3 Mount panels adjacent to associated equipment on vibration free walls or free standing angle iron supports.
- .4 Field panels are not to be located in ceiling spaces.
- .5 All main panels are to be located in Mechanical/Fan Rooms only.
- .6 All panels serving microzone controllers (reheat/radiation) should be located in fully recessed panels located in mechanical rooms, fan rooms, storage rooms or janitors' rooms. The panel locations are to be approved by the Departmental Representative during the shop drawing stage.
- .7 All field panels shall be labeled with lamicoid labels.

## **3 EXECUTION**

### **3.1 General**

- .1 The installation shall conform to each manufacturer's recommended procedures and to all applicable codes, statutes and ordinances.
- .2 All equipment installed shall be mechanically stable and, as necessary, fixed to wall or floor. Anti-vibration mounts to be provided, if required, for the proper isolation of the equipment.
- .3 Equipment shall be installed so as to allow for easy maintenance access. Equipment shall be installed such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.
- .4 Equipment shall be installed in locations providing adequate ambient conditions for its specified functioning, allowing for adequate ventilation.
- .5 System Expansion: Provide five spare input and five spare output points in each Mechanical Room for future expansion and renovations. In addition, further expansion of the system shall be possible by simply adding more controllers to the network. The system shall be expandable to a maximum capacity in excess of 2500 points without making any of the original equipment redundant. The central control console shall directly support a minimum of 99 stand alone controllers.
- .6 The DDC panel points shall be defined such that the primary input sensor for a PID loop resides on the same panel as the output.
- .7 Application specific controllers shall only be used where specified.
- .8 Controller Memory: The non-volatile ROM, EPROM, EEPROM memory will, as a minimum, support all performance and technical specifications, communications, operating system, executive, application subroutines, etc. and other configuration description software. Tape or disk media systems are not acceptable. All control

algorithms, application functions, and operating data or software shall reside in EEPROM. or battery backed RAM. That is, data or control program (such as I/O point characteristics, schedules, set points, alarm limits, and control sequences) must remain in EEPROM and/or RAM and hence modifiable on-line through an operators terminal connected to any panel on the system. RAM must include battery or other backup for a minimum of 72 hours to eliminate operating data reload in case of power failure.

- .9 Controller Diagnostics: Control panel diagnostics, for both the primary controller and the micro-controllers, shall consist of built-in, continuous operational and board level tests, software control sequence analysis and alarm exception logging. Light emitting diodes and/or the alphanumeric display shall annunciate hardware failures, and control program errors or problems.
- .10 All micro-controllers and central communications controllers shall be located in Mechanical rooms, Electrical rooms or Janitor rooms. Locations elsewhere shall be subject to Engineer's prior approval.
- .11 Application specific controllers shall have a minimum of one spare universal input and one spare universal output point for future connections. Point expander cards are not to be used in the original installation.
- .12 All controllers shall contain ports to interface to a Personal Computer. This access port shall provide full capabilities including programming.
- .13 The control system shall operate independently from the Host Computer Workstation. All control, inter-panel communications and data collection functions shall continue to operate when the Host Computer Workstation is taken off line.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED SECTIONS**

- .1        Section 01 01 50 – General Instructions
- .2        All specification sections prefix-numbered 26

**1.2                REFERENCES**

- .1        Canadian Standards Association (CSA International)
  - .1        CSA C22.1-12, Canadian Electrical Code, Part 1 (22<sup>nd</sup> Edition), Safety Standard for Electrical Installations.
  - .2        Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
    - .1        EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.

**1.3                DEFINITIONS**

- .1        Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

**1.4                DESIGN REQUIREMENTS**

- .1        Operating voltages: to CAN3-C235.
- .2        Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
  - .1        Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3        Language operating requirements: provide identification nameplates and labels for control items in English and French.
- .4        Use one nameplate or label for each language.

**1.5                SUBMITTALS**

- .1        Submittals: in accordance with Section 01 01 50 – General Instructions.
- .2        Submit copy of electrical permit for the project to Departmental Representative prior to commencement of work. Departmental Representative will provide drawings required by Electrical Inspection Department at no cost.
  - .1        Pay associated fees.
  - .2        Notify Departmental Representative of changes required by Electrical Inspection Department prior to making changes.
  - .3        Furnish certificate of acceptance from Electrical Inspection Department upon completion of the work.

- .3 Shop drawings:
  - .1 Submit shop drawings and product data.
  - .2 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
  - .3 Where applicable, include wiring, single line and schematic diagrams.
  - .4 Include wiring drawings or diagrams showing interconnection with work of other Sections.
  - .5 Submit 6 copies of shop drawings and product data to the Departmental Representative.
- .4 Provide operation and maintenance data for incorporation into operation and maintenance manual specified in Section 01 01 50 – General Instructions.  
Include in operations and maintenance data:
  - .1 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
  - .2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts list. Advertising or sales literature not acceptable.
  - .3 Wiring and schematic diagrams and performance curves.
  - .4 Names and addresses of local suppliers for items included in maintenance manuals.
  - .5 Copy of reviewed shop drawings.
- .5 Quality Control: in accordance with Section 01 01 50 – General Instructions.
  - .1 Provide CSA certified equipment and material.
  - .2 Submit test results of installed electrical systems.
  - .3 Permits and fees: in accordance with General Conditions of contract.
  - .4 Submit to Departmental Representative certificate of acceptance from authority having jurisdiction upon completion of Work.
- .6 Record Drawings
  - .1 Provide record drawings of the installation as specified in Section 01 01 50 – General Instructions.

## **1.6 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 01 50 – General Instructions.
- .2 Qualifications: electrical Work to be carried out by qualified personnel in accordance with the requirement of authorities having jurisdiction.

## **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.



- .2 Construction/Demolition Waste Management and Disposal: where applicable separate waste materials for recycling in accordance with Section 01 01 50 – General Instructions.

## **1.8 SYSTEM STARTUP**

- .1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Where applicable and as further specified, arrange and pay for services of manufacturer's factory service Departmental Representative to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

## **1.9 OPERATING INSTRUCTIONS**

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include following:
  - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
  - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
  - .3 Safety precautions.
  - .4 Procedures to be followed in event of equipment failure.
  - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

## **Part 2 Products**

### **2.1 MATERIALS AND EQUIPMENT**

- .1 Provide material and equipment in accordance with Section 01 01 50 – General Instructions.
- .2 Material and equipment to be CSA certified.
- .3 Factory assemble control panels and component assemblies.

### **2.2 WIRING TERMINATIONS**

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

### **2.3 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with nameplates and labels as follows:

.1 Nameplates: lamicoïd plastic engraving sheet, black face, white core, lettering accurately aligned and engraved into core attached with Loctite 414 adhesive. No pre-gummed labels are acceptable.

.2 Sizes as follows:

**NAMEPLATE SIZES**

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.2 Labels: plastic labels with 4mm high letters unless specified otherwise.

.3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.

.4 Allow for minimum of twenty-five (25) letters per nameplate and label.

.5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.7 Terminal cabinets and pull boxes: indicate system and voltage.

## **2.4 WIRING IDENTIFICATION**

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout to the existing systems that have been installed.

## **2.5 FINISHES**

.1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Do complete installation in accordance with CSA C22.1, BC Amendments, Directives and Bulletins except where specified otherwise.

**3.2 NAMEPLATES AND LABELS**

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

**3.3 FIRESTOPPING**

- .1 Where cables or conduits pass through floors and fire rated walls, pack space full with a ULC approved firestopping system.
- .2 Fire stopping is specified in Section 01 01 50 – General Instructions.

**3.4 LOCATION OF OUTLETS**

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000mm, and information is given before installation.

**3.5 FIELD QUALITY CONTROL**

- .1 Carry out tests in presence of Departmental Representative or his representative. Submit written test results for review.
- .2 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

**3.6 CLEANING**

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 At time of final cleaning, clean lighting reflectors, lenses and other lighting surfaces that have been exposed to construction dust and dirt.

**END OF SECTION**

**Part 1        General**

**Part 2        PRODUCTS**

**Part 3        EXECUTION**

**3.1            FIXING, HANGING**

- .1 All wiring shall be fixed to or hung from building structure and shall not be fixed to or hung from building services, i.e., ducts, pipes, electrical conduits, sprinkler pipes, etc.

**3.2            CONCEALMENT**

- .1 Wiring, in general, shall be concealed. Wiring may be concealed by running it in the crawlspace, in hollow walls and partitions and above ceilings.

**3.3            SURFACE WIRING IN FINISHED AREAS**

- .1 Finished areas of the building are all areas except the mechanical rooms and similar service rooms.
- .2 Any wiring proposed to be run exposed in finished areas of the buildings shall not be installed until all means of possible concealment have been investigated with the consultant. Such surface wiring shall be approved by the consultant as shall the routing.
- .3 Surface wiring in finished areas shall be enclosed in EMT unless otherwise indicated. Junction, pull and outlet boxes for surface wiring shall make use of wiremold boxes.

**3.4            USE OF EMT CONDUIT**

- .1 For concealed wiring:
  - .1 Wiring in ceiling spaces, e.g. above T-bar dropped plaster ceilings installed under this contract shall be installed in EMT conduit.
  - .2 Except as otherwise indicated or specified, all systems shall be wired in EMT conduit, including lighting, power, receptacles, fire alarm, and other systems including low voltage systems.
- .2 For exposed wiring:
  - .1 Exposed wiring installed in electrical and mechanical rooms shall be EMT conduit and wire.

**3.5            USE OF FLEXIBLE CONDUIT OR AC(BX) CABLE**

- .1 AC(BX) cable or flexible conduit may be used where wiring is concealed.
- .2 Where flexible conduit is used, provide ground bond wire in conduit.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED SECTIONS**

- .1        Section 01 01 50 – General Instructions
- .2        Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.
- .3        Section 26 05 00 – Common Work Results – For Electrical

**1.2                REFERENCES**

- .1        CSA C22.2 No .0.3, Test Methods for Electrical Wires and Cables.

**1.3                PRODUCT DATA**

- .1        Submit product data in accordance with Section 01 01 50 – General Instructions.

**Part 2            Products**

**2.1                BUILDING WIRES**

- .1        Conductors: Minimum size: 12 AWG.
- .2        Copper conductors: size as indicated, with 600V insulation of chemically cross-linked thermosetting polyethylene material rated RW90. Note: THHN not acceptable.
- .3        As armoured cable in accordance with Section 26 05 10.
  - .1        Armoured cable in tee-bar ceilings shall be fixed to structure at code required fixing spacings. Do not drape on ceiling tiles.

**2.2                ARMOURED CABLES**

- .1        Conductors: Minimum size: 12 AWG.
- .2        Type: AC 90
- .3        Armour. Interlocking Execution

**2.3                INSTALLATION OF BUILDING WIRES**

- .1        Install wiring as follows:
  - .1        In conduit systems in accordance with Section 26 05 34.
  - .2        In wireways and auxiliary gutters in accordance with Section 26 05 37.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED SECTIONS**

- .1        Section 01 01 50 – General Instructions
- .2        Section 26 05 00 – Common Work Results for Electrical
- .3        Section 26 05 31 – Splitters, Junctions, Pull Boxes and Cabinets
- .4        Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings
- .5        Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings
- .6        Section 26 05 37 – Wireways and Auxiliary Gutters

**Part 2            Products**

**2.1                SUPPORT CHANNELS**

- .1        U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1        Secure equipment to masonry, tile and plaster surfaces with lead anchors.
- .2        Secure equipment to poured concrete with expandable inserts.
- .3        Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4        Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5        Fasten exposed conduit or cables to building construction or support system using straps.
  - .1        One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
  - .2        Two-hole steel straps for conduits and cables larger than 50 mm.
  - .3        Beam clamps to secure conduit to exposed steel work.
- .6        Suspended support systems.
  - .1        Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
  - .2        Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .7        For surface mounting of two or more conduits use channels at code required centre spacing to suit smallest conduit installed.

- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .13 All hangers, supports and brackets shall be provided and be installed to be consistent with the requirements of Table 4.1.8.18 of Section 4 of the British Columbia Building Code.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED SECTIONS**

- .1            Section 01 01 50 – General Instructions
- .2            Section 26 05 00 – Common Work Results – For Electrical

**1.2                SHOP DRAWINGS AND PRODUCT DATA**

- .1            Submit shop drawings and product data for cabinets in accordance with Section 01 01 50 – General Instructions.

**Part 2            Products**

**2.1                SPLITTERS**

- .1            Sheet metal enclosure, welded corners and formed hinged or screw on cover. If hinged, suitable for locking in closed position.
- .2            Main and branch lugs or connection bars to match required size and number of incoming and outgoing conductors as indicated.
- .3            At least three spare terminals on each set of lugs in splitters less than 400 A.

**2.2                JUNCTION AND PULL BOXES**

- .1            Welded steel or aluminum construction with screw-on flat covers for surface mounting.
- .2            Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

**2.3                CABINETS**

- .1            Painted sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

**Part 3            Execution**

**3.1                SPLITTER INSTALLATION**

- .1            Install splitters and mount plumb, true and square to the building lines.
- .2            Extend splitters full length of equipment arrangement except where indicated otherwise.

**3.2                JUNCTION AND PULL BOXES INSTALLATION**

- .1            Install pull boxes in inconspicuous but accessible locations.
- .2            . Install pull boxes so as not to exceed 30m of conduit run between pull boxes.



**3.3 CABINETS**

- .1 Install cabinets for components as indicated.

**3.4 IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Install size 2 identification labels indicating system name, voltage and phase.

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCES**

- .1            CSA C22.1-2012, Canadian Electrical Code, Part 1.

**Part 2            Products**

**2.1                OUTLET AND CONDUIT BOXES GENERAL**

- .1            Size boxes in accordance with CSA C22.1.
- .2            102 mm square or larger outlet boxes as required for special devices.
- .3            Gang boxes where wiring devices are grouped.
- .4            Blank cover plates for boxes without wiring devices.
- .5            Combination boxes with barriers where outlets for more than one system are grouped.

**2.2                SHEET STEEL OUTLET BOXES**

- .1            Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2            Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .3            102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .4            102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster or tile walls.

**2.3                CONDUIT BOXES**

- .1            Cast FS or FD aluminum or feraloy boxes with factory-threaded hubs and mounting feet for surface wiring of components and devices.
- .2            Surface wiremold boxes. Boxes without knockouts.

**2.4                FITTINGS - GENERAL**

- .1            Bushing and connectors with nylon insulated throats.
- .2            Knock-out fillers to prevent entry of debris.
- .3            Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4            Double locknuts and insulated bushings on sheet metal boxes.

- .5 Screwed fittings for rigid galvanized screwed steel conduit installations.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.
- .2 Use FS or FD boxes or wiremold boxes for surface mounted outlets and junction boxes.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit connections. Reducing washers are not allowed.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 01 50 – General Instructions
- .2 Section 26 05 00 – Common Work Results – For Electrical

**1.2 REFERENCES**

- .1 Canadian Standards Association
  - .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
  - .2 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .3 CSA C22.2 No. 83, Electrical Metallic Tubing.
  - .4 CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.

**1.3 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 01 50 – General Instructions.

**Part 2 Products**

**2.1 CONDUITS**

- .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with steel fittings.
- .2 Flexible metal conduit: to CSA C22.2 No. 56, steel or aluminum liquid-tight flexible metal.
- .3 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.

**2.2 CONDUIT FASTENINGS**

- .1 One hole steel straps to secure surface conduits 50 mm and smaller, except as otherwise noted. See drawings and clause 3.2.5 in this section.
  - .1 Two hole steel straps for conduits larger than 50 mm, except as otherwise noted for smaller conduits. See drawings and clause 3.2.5 in this section.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

**2.3 CONDUIT FITTINGS**

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified.

- .1 Coating: same as conduit.
- .2 Material: Steel (Cast fittings are not acceptable).
- .2 Factory "ells" where 90 degrees bends for 21 mm and larger conduits.

## **2.4 FISH CORD**

- .1 Polypropylene.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits where possible except in mechanical and electrical service rooms and in unfinished areas.
- .3 Surface mount conduits in mechanical and electrical rooms, unfinished areas and elsewhere as noted on the drawings.
- .4 Use electrical metallic tubing EMT except as otherwise indicated.
- .5 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp or wet locations.
- .6 Minimum conduit size: 21mm.
- .7 Bend conduit cold:
  - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .8 Mechanically bend steel conduit over 19 mm diameter.
- .9 Unless indicated otherwise, provide conduit for all wiring and for future use as further specified or noted on the drawings.

### **3.2 SURFACE CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Run conduits in flanged portion of structural steel.
- .3 Group conduits wherever possible on suspended or surface U-channels.
- .4 Do not pass conduits through structural members except as indicated.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED SECTIONS**

- .1        Section 01 01 50 – General Instructions
- .2        Section 26 05 00 - Common Work Results - Electrical.

**1.2                REFERENCES**

- .1        Canadian Standards Association.
  - .1        CSAC22.2No.26, Construction and Test of Wireways, Auxiliary Gutters and Associated Fittings.

**1.3                PRODUCT DATA**

- .1        Submit product data in accordance with 01 01 50 – General Instructions.

**Part 2            Products**

**2.1                WIREWAYS**

- .1        Wireways and fittings: to CSA C22.2 No.26.
- .2        Sheet steel with hinged or bolted cover to give uninterrupted access.
- .3        Finish: baked grey enamel if of steel, aluminum.
- .4        Elbows, tees, couplings and hanger fittings manufactured as accessories to wireway supplied.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1        Install wireways and auxiliary gutters.
- .2        Keep number of elbows, offsets, connections to minimum.
- .3        Install supports, elbows, tees, connectors, fittings.
- .4        Install barriers where required.
- .5        Install gutter to full length of equipment.
- .6        Do not install wireways or auxiliary gutters in areas accessible to inmates.

**END OF SECTION**

**APPENDIX A**

**MECHANICAL  
SCHEDULES**





<b>HEATING AND VENTILATING UNITS</b>				
Mark	AHU-1 SF EX		AHU-1 RF EX	
Service	CSB		CSB	
Model	EA-LM-6-C		9624 Arr. 4	
Fan Air Flow - L/s (cfm)	3304	7000	2171	4600
Fan External S.P. - Pa (in w.g.)	137.5	0.55	220	0.9
Fan Total S.P. - Pa (in w.g.)	400	1.6		
Fan Size/Type	18/18 / FC DIDW		24" $\phi$ Impeller	
Fan RPM	750		1750	
Fan Horsepower	5		1.5	
Filter Area - Square Meters (sq. Ft.)	1.4	15.0		
Weight - kg (lbs.)	408	900		
Notes	1		2	
<p>Interlock operation of supply fan with return fan as scheduled.  Refer to Specification for accessories not scheduled. Refer to drawings for installation details.  1. Existing Unit manufactured by Engineered Air. Replace existing fan motor, drives, heating coil, sheaves as specified and scheduled  2. Unit is to be as manufactured by Sheldon or approved equal.</p>				

<b>HEATING COILS</b>		
Mark	HC-1	
Unit	AHU-1	
Type	HOT WATER	
Air Flow - L/s (cfm)	3165	6706
Air P.D. - Pa (in w.g.)	138	0.55
Ent. Air Temp °C (°F)	4.0	39.2
Lvg. Air Temp °C (°F)	28.4	83
Ent. Water Temp °C (°F)	82.2	180.0
Lvg. Water Temp °C (°F)	50.6	123
Heating Cap. - kW (MBH)	93	318.2
Water Flow - L/s (gpm)	0.72	11.40
Water P.D. - kPa (ft.)	0.63	0.21
Notes		
<p>Existing Unit manufactured by Engineered Air. Replace existing heating coil as specified and scheduled</p> <p>Refer to Specification for accessories not scheduled. Refer to drawings for installation details.</p>		

<b>PUMPS</b>			
Mark	P-1	P-2	P-3

Model	1050 2B		1050 2B		HD3	
Location	Boiler Rm		Boiler Rm		MECHANICAL RM	
Service	Secondary pump		Secondary pump		AHU-1	
Flow - L/sec (usgpm)	1.58	25	1.58	25	0.76	12
Head - kPa (ft.)	60	20	60	20	36	12
Pipe Size - mm (in.)	51	2	51	2	38	1.5
Horsepower	0.5		0.5		0.33	
Notes	2		2		1	

Mark	B-P2		B-P3	
Model	15-58 FC		15-58 FC	
Location	Boiler Rm		Boiler Rm	
Service	Boiler # 2		Boiler # 3	
Flow - L/sec (usgpm)	1.10	18	1.10	18
Head - kPa (ft.)	58.2	19.4	58.2	19.4
Pipe Size - mm (in.)	51	2	51	2
Horsepower	0.04		0.04	
Notes	3		3	

Pumps shall be installed with service clearances as required by pump manufacturer  
Motors to be suitable for 120V/1ph/60 power and 1750 rpm unless noted otherwise.

**NOTES**

1. Pump shall be manufactured by ITT B&G (1725 rpm, dual voltage 115V/1ph/60hz or 230V/1ph/60hz)
2. Pump shall be manufactured by Armstrong (1800 RPM, dual voltage 120V/1ph/60hz or 208V/3ph/60hz)
3. Pump shall be manufactured by Grundfos ( RPM, 115V/1ph/60hz)

**EXHAUST FANS**

Mark	EF-4		EF-5		EF-9		EF-10	
Service	Men's WR Unisex WR		Welding RM		Carpentry Storage		Battery Room	
Model	VIDK-10		VUBK-15		SQ-70-G		VIDK-08	
Air Flow - L/s (cfm)	117	247	566	1200	54	114	57	120
External S.P. - Pa (in w.g.)	125	0.5	325	1.3	56.5	0.2	125	0.5
Horsepower	0.09		0.75		0.02		0.09	
Voltage/Phase (V/ph)	115	1	115	1	115	1	115	1
RPM	1050		1250		1300		1400	
Sones	5		19.5		2.7		5.9	
Notes	4		1,2,5		2, 6		2,3	

Fans shall be as manufactured by Carnes or approved equal unless noted otherwise. Refer to specification for accessories not scheduled. Refer to drawings for installation details.

1. Complete with manual switch by Div. 16. Fan shall run intermittently.
2. Fan shall be complete with belt guard, special motor, explosion proof and spark proof motor enclosure.
3. Fan shall run continuously. Control contractor to provide fan status to DDC.

4. Fan to be interlocked with building occupied mode of operation by Control contractor. Provide fan status to DDC.

5. Spun and shaped aluminum housing, integral drain opening, integral motor overload protection, electrical to provide starter and disconnect, adjustable motor sheave factory preset to requested rpm, ventilated motor compartment with motor out of airstream, non-overloading backwardly inclined wheel, isolated suspended motor wheel-drive assembly, spark resistant construction, polished CRS fan shaft with rust inhibitive coating, pillow block bearing L50 = 200,000 hrs, provide explosion proof motor.

6. Fan shall be manufactured by Greenheck or approved equal.

**GRILLES, REGISTERS, DIFFUSERS**

Mark	EG-1
Service	Exhaust
Model	80D/TB
Damper	
Finish	B12
Notes	
<p>Grilles, Registers and Diffusers to be as manufactured by E.H. Price or approved equal.</p> <p>B12 finish denotes factory white baked enamel finish.</p>	

**Boilers**

	B-2		B-3	
Mark	Boiler Rm (206)		Boiler Rm (206)	
Location	Weil-McLain CGi-6		Weil-McLain CGi-6	
Model	48.9	167.0	48.9	167.0
Gas Input, High Fire - kW (MBH)	41.0	140.0	41.0	140.0
Gas Output, High Fire - kW (MBH)	164.5	362.0	164.5	362.0
Operating Weight - kg (lbs.)				
Notes	<p>Units shall be provided by the Departmental Representative. Units shall be available on site.            Units tested at a working pressure of 345 kPa (50 PSI).            Units fuelled by natural gas.</p>			



**APPENDIX B**

**HAZMAT BUILDING  
MATERIALS ASSESSMENT**





**Pre-renovation Hazardous  
Building Materials  
Survey Report**

**Combined Services Building  
Sandspit Airport  
Sandspit, BC**



*Prepared for:*  
**Public Works and Government Services Canada**  
641 – 800 Burrard Street  
Vancouver, BC V6Z 2V8

Attention: Mr. David Mower  
*Architectural Technologist*

September 21, 2011

PHH ARC Project No. 12166C

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## EXECUTIVE SUMMARY

PHH ARC Environmental Ltd. (PHH ARC) was retained by Public Works & Government Services Canada (PWGSC) to conduct a pre-renovation hazardous building materials survey of the Combined Services Building located at the Sandspit Airport, Sandspit, BC. The survey was performed by Hien Nguyen, *Senior Project Coordinator* on September 8, 2011.

The objective of the survey was to identify specified hazardous building materials in preparation for building renovation. The results of this survey are intended to be used in conjunction with a properly developed specification.

### Summary of Findings

Hazardous Material	Type / Location
Asbestos-containing building materials (ACMs)	<p>Black window putty applied to the glazing of the man doors.</p> <p>Black window putty applied to the glazing of the overhead sectional doors.</p> <p>Black window putty applied to the glazing of the windows on the North and South facades.</p>
Lead in paints	<p>Cream paint applied to metal man door frames within Stair #2 (Loc. 7) was determined to contain 0.28% lead.</p> <p>Grey paint applied to fire man doors within Stair #2 (Loc. 7) was determined to contain 0.097%.</p> <p>Blue paint applied to metal corrugated panels was determined to contain 0.92% lead.</p> <p>White paint applied to drywall throughout renovation zone was determined to contain 0.19% lead.</p>
Lead products	Solid lead is present in emergency light batteries throughout the building.
Crystalline Silica	Concrete floor throughout the building contains crystalline silica.
Mercury	Mercury vapour is present in light tubes located throughout the building.
Polychlorinated biphenyls (PCBs)	The building has not been re-lamp with new energy efficient light ballast and lamps. Assume all light ballasts throughout the building to contain PCBs.
Halocarbons	Halocarbons were not observed.
Mould	Visible mould was not observed.

## EXECUTIVE SUMMARY – CONTINUED

### Summary of Recommendations

1. The hazardous materials identified must be safely contained, treated or removed if disturbed by renovation activity.
2. Prior to renovation work, prepare specifications for hazardous material removal. The specifications should include and address the scope of work, safe work practices, risk assessments and personal protective equipment and respiratory protection.
3. Retain a qualified consultant to specify, inspect and verify the successful handling and/or removal of all hazardous materials.
4. Prior to renovation work, remove, transport and dispose of ACMs, lead products, mercury, halocarbons, and PCBs in accordance with all federal and provincial regulations as listed in Appendix I.
5. During renovation work, follow safe work procedures when disturbing leaded paint, cutting or grinding concrete and other items containing crystalline silica in accordance with all federal and provincial regulations as listed in Appendix I.

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## 1.0 INTRODUCTION AND SCOPE

PHH ARC Environmental Ltd. (PHH ARC) was retained by Public Works & Government Services Canada (PWGSC) to conduct a pre-renovation hazardous building materials survey of the Combined Services Building located at the Sandspit Airport in Sandspit, BC. This report fulfills the requirements of Section 119 of the Workers' Compensation Act and Section 20.112 of the Occupational Health and Safety Regulation. This requires that the Owner report the presence of hazardous materials to the Prime Contractor to identify and eliminate or control hazards at the workplace.

The survey was performed by Hien Nguyen, *Senior Project Coordinator* on September 8, 2011. The surveyor was accompanied by Mr. Warren Foster of Transport Canada during the site work.

The hazardous materials included in this survey were;

- asbestos-containing building materials (ACMs)
- lead in paints and other lead products
- crystalline silica
- mercury
- polychlorinated biphenyls (PCBs)
- halocarbons
- mould

The scope of work was limited to the areas, items and materials designated for renovation ("the renovation zone"). The renovation zone is detailed in the email received from Mr. David Mower of PWGSC on August 31, 2011. The renovation zone included the following areas only:

- Roof including caulking and mastics;
- Exterior man doors including adjacent drywall taping compound on walls only;
- Overhead sectional doors including adjacent drywall taping compound on walls and pipe insulation on pipe fittings only;
- Exterior windows including adjacent drywall taping compound on walls only; and
- Exterior metal corrugated panels.

The objective of the survey was to identify specified hazardous building materials in preparation for building renovation. The results of this survey are intended to be used in conjunction with a properly developed building renovation specification.

## 2.0 GENERAL METHODOLOGY

A room-by-room survey (rooms, corridors, service areas, exterior, etc) of the renovation zone was conducted to identify the hazardous materials listed in the scope of work. This survey included an intrusive investigation to view concealed conditions behind solid walls, enclosures, shafts and chases.

Representative samples were collected and/or visual observation of the hazardous materials was conducted.

This survey excludes the following:

- owner or occupant articles (e.g. stored items, furniture, appliances, etc.);
- underground materials or equipment (e.g. vessels, drums, underground storage tanks, pipes, etc.); and
- areas, items, building materials outside of the renovation zone.

A unique location number was assigned to each room or homogenous area within the renovation zone. For further information on specific methodologies refer to Appendix V.

### 3.0 BUILDING INFORMATION

#### 3.1 Description

Item	Details
Construction Date	Circa 1970
Number of Phases	1
Number of Floors	1
Use and Size of Building	Combined Services Building ~11,000 ft <sup>2</sup>
Structure	Wood
Exterior Cladding	Metal corrugated panels
HVAC	Ceiling mounted heaters, baseboard electric heaters
Roof	Built-up roofing
Flooring	Vinyl tile, concrete
Interior Walls	Drywall, plywood
Ceilings	Drywall

#### 3.2 Inaccessible Areas

The following areas, locations or systems within the renovation zone were not accessible, operational or energized and were therefore not evaluated or tested as part of this survey.

Area or Room or Systems	Reason
No inaccessible areas or systems encountered	NA

#### 4.0 FINDINGS - IDENTIFIED HAZARDOUS MATERIALS

The following tables describe the hazardous materials identified in this survey. For complete test results (including materials determined to be a non-hazardous material), refer to Appendix II.

**Table 1 Asbestos-containing Materials**

System / Material	Locations	Sample #s)	Asbestos Content / Type	Estimated Quantity
<b>Other:</b> Black window putty applied to the glazing of the man doors.	Throughout the renovation zone.	S006	5% Chrysotile	4 each
<b>Other:</b> Black window putty applied to glazing of the overhead sectional doors.	Throughout the renovation zone.	S007	5% Chrysotile	5 each
<b>Other:</b> Black window putty applied to glazing of the windows on the North and South facades.	Throughout the renovation zone.	VS007	5% Chrysotile	23 each

**Table 2 Lead in Paint<sup>1</sup>**

Component or Substrate and Colour	Location(s)	Sample #s)	Test Result (%)	Estimated Quantity
Metal man door frame, cream	Stair #2	LB02	0.28	7 each 175 ft <sup>2</sup>
Metal fire man door, grey	Stair #2	LB04	0.097	7 each 224 ft <sup>2</sup>
Metal corrugated panels, blue	Exterior	LB05	0.92	Throughout renovation zone.

<sup>1</sup> WorkSafe BC has stated that lead concentrations as low as 0.009% (90 mg/kg) may present a risk to pregnant women and children. For lead in paints greater than or equal to 0.009%, refer to Appendix II-D.

Component or Substrate and Colour	Location(s)	Sample #(s)	Test Result (%)	Estimated Quantity
Drywall, white	Throughout the renovation zone.	LB08	0.19	Throughout renovation zone.

**Table 3 Lead Products**

Component	Estimated Quantity	Locations
Back-up emergency lights, lead-acid batteries.	All	Throughout the building.

**Table 4 Crystalline Silica**

Component	Locations
Concrete floor.	Throughout the building.

**Table 5 Mercury**

Component	Estimated Quantity	Locations
Light tubes	All	Throughout the building.

**Table 6 Polychlorinated Biphenyls**

Type	Estimated Quantity	Locations	Conclusions
Ballasts within light fixtures.	All	Throughout renovation zone.	The building has not been re-lamp with new energy efficient light ballast and lamps. Assume all light ballasts throughout the building to contain PCBs.



## 5.0 RECOMMENDATIONS

1. The hazardous materials identified must be safely contained, treated or removed if disturbed by renovation activity.
2. Prior to renovation work, prepare specifications for hazardous material removal. The specifications should include and address the scope of work, safe work practices, risk assessments and personal protective equipment and respiratory protection.
3. Retain a qualified consultant to specify, inspect and verify the successful handling and/or removal of all hazardous materials.
4. Prior to renovation work, remove, transport and dispose of ACMs, lead products, mercury and PCBs in accordance with all federal and provincial regulations as listed in Appendix I.
5. During renovation work, follow safe work procedures when disturbing leaded paint, cutting or grinding concrete and other items containing crystalline silica in accordance with all federal and provincial regulations as listed in Appendix I.

## 6.0 STANDARD LIMITATIONS

The work performed by PHH ARC was conducted in accordance with generally accepted engineering or scientific practices current in this geographical area at the time the work was performed. No warranty is either expressed or implied by furnishing written reports or findings. The Client acknowledges that subsurface and concealed conditions may vary from those encountered or inspected. PHH ARC can only comment on the environmental conditions observed on the date(s) the survey is performed. The work is limited to those materials or areas of concern identified by the Client or outlined in our proposal. Other areas of concern may exist but were not investigated within the scope of this assignment.

PHH ARC makes no other representations whatsoever, including those concerning the legal significance of its findings, or as to other legal matters touched on in this report, including, but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issue, regulatory statutes are subject to interpretation and these interpretations may change over time. PHH ARC accepts no responsibility for consequential financial effects on transactions or property values, or requirements for follow-up actions and costs.

The liability of PHH ARC, or its staff, will be limited to the lesser of the fees paid or actual damages incurred by the Client. PHH ARC will not be responsible for any consequential or indirect damages. PHH ARC is only liable for damages resulting from negligence of PHH ARC. All claims by the Client shall be deemed relinquished if not made within two years after last date of services provided.

Information provided by PHH ARC is intended for Client use only. PHH ARC will not provide results or information to any party unless disclosure by PHH ARC is required by law. Any use by a third party of reports or documents authored by PHH ARC or any reliance by a third party on or decisions made by a third party based on the findings described in said documents, is the sole responsibility of such third parties. PHH ARC accepts no responsibility for damages suffered by any third party as a result of decisions made or actions conducted. No other warranties are implied or expressed.

## 7.0 CLOSURE

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Per:



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12166CR01\_Final.doc



**APPENDIX I**  
**REFERENCES**



1. Occupational Health and Safety Regulation, (B.C. Reg. 296/97, as amended), under WorkSafe BC.
2. Safe Work Practices for Handling Asbestos, WorkSafe BC, 2006 Edition.
3. Hazardous Waste Regulation, BC Ministry of Environment; including amendments up to B.C. Reg. 261/2006, September 21, 2006.
4. Ozone Depleting Substances and Other Halocarbons Regulation, B.C. Reg. 220/2006, Environmental Management Act.
5. PCB Regulations, SOR/2008-273, Canadian Environmental Protection Act.
6. Lead-Containing Paint and Coatings, Preventing Exposure in the Construction Industry, Worksafe BC, June 2011.
7. Transportation of Dangerous Goods Regulations SOR/2008-34, Transportation of Dangerous Goods Act.
8. Federal Register, 40 CFR Part 745 Lead; Identification of Dangerous Levels of Lead; Final Rule, Environmental Protection Agency, January 5, 2001.





**APPENDIX II**  
**HAZARDOUS MATERIALS TESTING RESULTS**



**APPENDIX II-A**  
**SUMMARY OF NON-ASBESTOS MATERIALS**



### Summary of Non-asbestos Materials

Material	Sample #(s)	Locations
<b>Floor:</b> Vinyl floor tiles.	S005	Stair #2 (Loc. 7)
<b>Floor:</b> Mastic on underside of floor tiles.*  * The results apply to only the areas in which mastic was sampled, and cannot be extrapolated to areas where similar vinyl floor tile is present.	S005	Stair #2 (Loc. 7)
<b>Ceiling:</b> Drywall.	VS009A-E	Stair #1 (Loc.2) and Stair #2 (Loc.7)
<b>Wall:</b> Perimeter drywall.	S009A-F	Throughout renovation zone.
<b>Structure:</b> Firestop material at wall and floor penetrations.	NA	None observed.
<b>Pipe:</b> Parging cement on pipe fittings.	S012A-B	Maintenance Garage (Loc. 1) and Fire Hall (Loc. 5)
<b>Pipe:</b> Parging cement on pipe fittings.	S013A-B	Maintenance Garage (Loc. 1)
<b>Pipe:</b> Preformed insulation on straight sections of hot and cold water system pipes.	Fibreglass Insulation	Throughout renovation zone.
<b>Pipe:</b> Cement.	NA	None Observed
<b>Pipe:</b> Tar mastic.	NA	None Observed
<b>Duct:</b> Paper wrap.	NA	None Observed
<b>Mechanical:</b> Preformed insulation.	NA	None Observed
<b>Other:</b> Roofing material.	S001	Rooftop (Loc. 8)
<b>Other:</b> Roofing material	S002	Lower level Rooftop (Loc. 9)
<b>Other</b> Grey caulking	S003	Rooftop (Loc. 8)
<b>Other:</b> Yellow caulking	S004	Rooftop (Loc. 8)
<b>Other:</b> Black mastic	S008	Rooftop (Loc. 8)

---

Material	Sample #(s)	Locations
<b>Other:</b> Grey window caulking	S010	ECG/Lecture Office (Loc. 3)
<b>Other:</b> Black window putty	S011	Chief Office (Loc. 4)

**APPENDIX II-B**  
**ASBESTOS SAMPLING LOG**





**Asbestos Sampling Log / Homogeneous Materials**

<b>Homogeneous Material*</b>	<b>Sample No.</b>	<b>Location</b>
<b>Other:</b> Roofing material	S001	Rooftop (Loc. 8)
<b>Other:</b> Roofing material	S002	Rooftop (Loc. 9)
<b>Other:</b> Grey caulking (on heater vent on roof)	S003	Rooftop (Loc. 8)
<b>Other:</b> Yellow caulking (on heater vent on roof)	S004	Rooftop (Loc. 8)
<b>Flooring:</b> Vinyl floor tile, 12x12, beige with grey streaks	S005	Stair #2 (Loc. 7)
<b>Other:</b> Black window putty	S006	Stair #2 (Loc. 7)
<b>Other:</b> Black window putty	S007	Maintenance Garage Door #2 (Loc. 1)
<b>Other:</b> Black Mastic (around roof hatch)	S008	Rooftop (Loc. 8)
<b>Wall:</b> Perimeter drywall	S009A-F	Throughout renovation zone
<b>Other:</b> Grey window caulking	S010	ECG/Lecture Office (Loc. 3)
<b>Other:</b> Black window putty	S011	Chief Office (Loc. 4)
<b>Pipe:</b> Parging cement on drain water pipe	S012A-B	Maintenance Garage Door #1 (Loc. 1)
<b>Pipe:</b> Parging cement on hot and cold water	S013A-B	Maintenance Garage (Loc. 1)

\* A homogenous material is defined as material that is uniform in texture and appearance, was installed at one time, and is unlikely to consist of more than one type or formulation of material.



**APPENDIX II-C**  
**ASBESTOS LABORATORY CERTIFICATE**





# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** PHH ARC Environmental  
Suite 406-13251 Delf Place  
Richmond, BC V6V2A2

**Attn:** Hien Nguyen  
Bryan Zecchel

**Lab Order ID:** 1112881

**Analysis ID:** 1112881PLM

**Date Received:** 9/13/2011

**Date Reported:** 9/14/2011

**Project:** Combined Services Building Sands

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				
S001 - A	Roofing material, Combined Services Building	None Detected	10% Fiber Glass	90% Other	Gray, Black Non Fibrous Heterogeneous
1112881PLM_1	shingle				Dissolved
S001 - B	Roofing material, Combined Services Building	None Detected	98% Cellulose	2% Other	Brown Fibrous Homogeneous
1112881PLM_21	insulation				Teased
S001 - C	Roofing material, Combined Services Building	None Detected	70% Cellulose	30% Other	Black Non Fibrous Heterogeneous
1112881PLM_22	felt				Dissolved
S001 - D	Roofing material, Combined Services Building	None Detected		100% Other	White Non Fibrous Homogeneous
1112881PLM_23	foam				Ashed
S002 - A	Roofing material, lower level front roof, Combined Services Building	None Detected	10% Fiber Glass	90% Other	Gray, Black Non Fibrous Heterogeneous
1112881PLM_2	shingle				Dissolved
S002 - B	Roofing material, lower level front roof, Combined Services Building	None Detected	98% Cellulose	2% Other	Brown Fibrous Homogeneous
1112881PLM_24	insulation				Teased
S002 - C	Roofing material, lower level front roof, Combined Services Building	None Detected	70% Cellulose	30% Other	Black Non Fibrous Heterogeneous
1112881PLM_25	felt				Dissolved
S002 - D	Roofing material, lower level front roof, Combined Services Building	None Detected		100% Other	White Non Fibrous Homogeneous
1112881PLM_26	foam				Ashed

**Disclaimer:** Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Bart Huber (27)

Analyst

Scientific Analytical Institute, Inc. 302-L Pomona Dr. Greensboro, NC 27407 (336) 292-3888

Nathaniel Durham, MS or Approved Signatory

Page 1 of 4



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



NVLAP Lab Code: 200664-0

**Customer:** PHH ARC Environmental  
Suite 406-13251 Delf Place  
Richmond, BC V6V2A2

**Attn:** Hien Nguyen  
Bryan Zecchel

**Lab Order ID:** 1112881

**Analysis ID:** 1112881PLM

**Date Received:** 9/13/2011

**Date Reported:** 9/14/2011

**Project:** Combined Services Building Sands

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
S003	Grey caulking on infrared heater vent on the roof, Combined Services Bldg	None Detected	5% Fiber Glass	95% Other	Gray Non Fibrous Homogeneous
1112881PLM_3					Dissolved
S004	Yellow caulking on infrared heater vent on the roof, Combined Services Bldg	None Detected		100% Other	Yellow Non Fibrous Homogeneous
1112881PLM_4					Dissolved
S005 - A	VFT (12x12 beige w/grey streaks) + black mastic within stair #2, Combined Services tile	None Detected		100% Other	Beige Non Fibrous Homogeneous
1112881PLM_5					Dissolved
S005 - B	VFT (12x12 beige w/grey streaks) + black mastic within stair #2, Combined Services mastic	None Detected		100% Other	Black Non Fibrous Homogeneous
1112881PLM_27					Dissolved
S006	Black Window Putty Loc. Exterior Door to Stair #2	5% Chrysotile	5% Cellulose	90% Other	Black Non Fibrous Heterogeneous
1112881PLM_6					Dissolved
S007	Window Putty Loc. Exterior Garage #2 Door	5% Chrysotile		95% Other	Gray Non Fibrous Heterogeneous
1112881PLM_7					Dissolved
S008	Black Mastic Loc. Around Roof Hatch	None Detected		100% Other	Black Non Fibrous Homogeneous
1112881PLM_8					Dissolved
S009A	DTC Perimeter Wall Loc. Above Exit Door at the Stair	None Detected		100% Other	White Non Fibrous Homogeneous
1112881PLM_9					Crushed

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Bart Huber (27)

Analyst

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Page 2 of 4



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** PHH ARC Environmental  
Suite 406-13251 Delf Place  
Richmond, BC V6V2A2

**Attn:** Hien Nguyen  
Bryan Zecchel

**Lab Order ID:** 1112881

**Analysis ID:** 1112881PLM

**Date Received:** 9/13/2011

**Date Reported:** 9/14/2011

**Project:** Combined Services Building Sands

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
S009B	DTC Perimeter Wall Loc. Maintenance Garage	None Detected		100% Other	White Non Fibrous Homogeneous
1112881PLM_10					Crushed
S009C	DTC Perimeter Wall Loc. Chief Office	None Detected		100% Other	White Non Fibrous Homogeneous
1112881PLM_11					Crushed
S009D	DTC South Perimeter Wall Loc. Fire Hall	None Detected		100% Other	White Non Fibrous Homogeneous
1112881PLM_12					Crushed
S009E	DTC Perimeter Wall Loc. Staircase #1	None Detected		100% Other	White Non Fibrous Homogeneous
1112881PLM_13					Crushed
S009F	DTC Perimeter Wall Loc. Garage	None Detected		100% Other	White Non Fibrous Homogeneous
1112881PLM_14					Crushed
S010	Exterior Grey Window Caulking Loc. ECG/Liture Office	None Detected		100% Other	Gray Non Fibrous Homogeneous
1112881PLM_15					Ashed
S011	Black Window Putty Loc. Chief Office	None Detected		100% Other	Black Non Fibrous Heterogeneous
1112881PLM_16					Dissolved
S012A	Parging Cement On Drain Water Pipe Elbow Loc. Above Garage Door #1	None Detected	10% Cellulose 5% Fiber Glass	85% Other	Gray Non Fibrous Homogeneous
1112881PLM_17			Crushed		

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommended that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Bart Huber (27)

Analyst

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Nathaniel Durham, MS or Approved Signatory

Page 3 of 4



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



NVLAP Lab Code: 200664-0

Customer: PHH ARC Environmental  
Suite 406-13251 Delf Place  
Richmond, BC V6V2A2

Attn: Hien Nguyen  
Bryan Zecchel

Lab Order ID: 1112881

Analysis ID: 1112881PLM

Date Received: 9/13/2011

Date Reported: 9/14/2011

Project: Combined Services Building Sands

Sample ID	Description	Asbestos	Fibrous Components		Non-Fibrous Components		Attributes
Lab Sample ID	Lab Notes						Treatment
S012B	Parging Cement On Drain Water Elbow Loc. Above Garage Door #1	None Detected	10% 5%	Cellulose Fiber Glass	85%	Other	Gray Non Fibrous Homogeneous
1112881PLM_18							Crushed
S013A	Parging Cement On Hot and Cold Water Loc. Garage	None Detected	10% 5%	Cellulose Fiber Glass	85%	Other	Gray Non Fibrous Homogeneous
1112881PLM_19							Crushed
S013B	Parging Cement On Hot and Cold Water Loc. Garage	None Detected	10% 5%	Cellulose Fiber Glass	85%	Other	Gray Non Fibrous Homogeneous
1112881PLM_20							Crushed

Disclaimer: Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Estimated MDL is 0.1%.

Bart Huber (27)

Analyst

Nathaniel Durham, MS or Approved Signatory



**APPENDIX II-D**  
**LEAD LABORATORY CERTIFICATE**





# Analysis for Lead Concentration in Paint Chips

by Flame Atomic Absorption Spectroscopy  
EPA SW-846 3rd Ed. Method No. 3050B/Method No. 7420



Customer: PHH ARC Environmental  
Suite 406-13251 Delf Place  
Richmond BC V6V2A2

Attn: Hien Nguyen

Lab Order ID: 1112886

Analysis ID: 1112886\_PBP

Date Received: 9/13/2011

Date Reported: 9/15/2011

Project: 12166C Combined Services Building

Sample ID	Description	Mass	Analytical Sensitivity	Concentration
Lab Sample ID	Lab Notes	(g)	(% by weight)	(% by weight)
LB01	Cap flashing loc roof top	0.0253	0.002%	0.006%
1112886PBP_1				
LB02	Cream on metal door frame loc stair #2	0.0639	0.002%	0.28%
1112886PBP_2				
LB03	Blue on fire door loc stair #2	0.0543	0.002%	0.048%
1112886PBP_3				
LB04	Grey on fire door loc stair #2	0.0278	0.005%	0.097%
1112886PBP_4				
LB05	Blue/white exterior metal ladding loc outside exterior	0.0502	0.003%	0.92%
1112886PBP_5				
LB06	White on garage metal door frame loc garage door #1	0.0644	0.002%	0.049%
1112886PBP_6				
LB07	White on galvanized garage door loc garage door #2	0.0539	0.002%	<0.007%
1112886PBP_7				
LB08	White on DTC perimeter wall loc stair #2	0.0505	0.003%	0.19%
1112886PBP_8				
LB09	Off white exterior metal cladding loc exterior combined building	0.1051	0.001%	0.007%
1112886PBP_9				

Scientific Analytical Institute successfully participates in the AIHA ELPAT for Lead program. ELPAT Laboratory ID: 173190 (R.L. = 0.01 wt.%)  
The quality control samples run with the samples in this report have passed all AIHA required specifications unless otherwise noted.

Robert Duke (9)

Analyst

Scientific Analytical Institute, Inc. 302-L Pomona Dr. Greensboro, NC 27407 (336) 292-3888

Approved Signatory



**APPENDIX III**

**DRAWINGS**





LEGEND

- (XX) LOCATION NUMBER
- (3) ASBESTOS BULK SAMPLE NUMBER
- (4) LEAD BULK SAMPLE NUMBER



THE PINCHIN GROUP



CLIENT:

PUBLIC WORKS AND  
GOVERNMENT SERVICES  
CANADA

641 - 800 BURRARD ST  
VANCOUVER, BC V6Z 2V8

DRAWING NAME:

MAIN LEVEL  
#18 COMBINED SERVICES BUILDING  
SANDSPIT, BC

SCALE:  
NTS

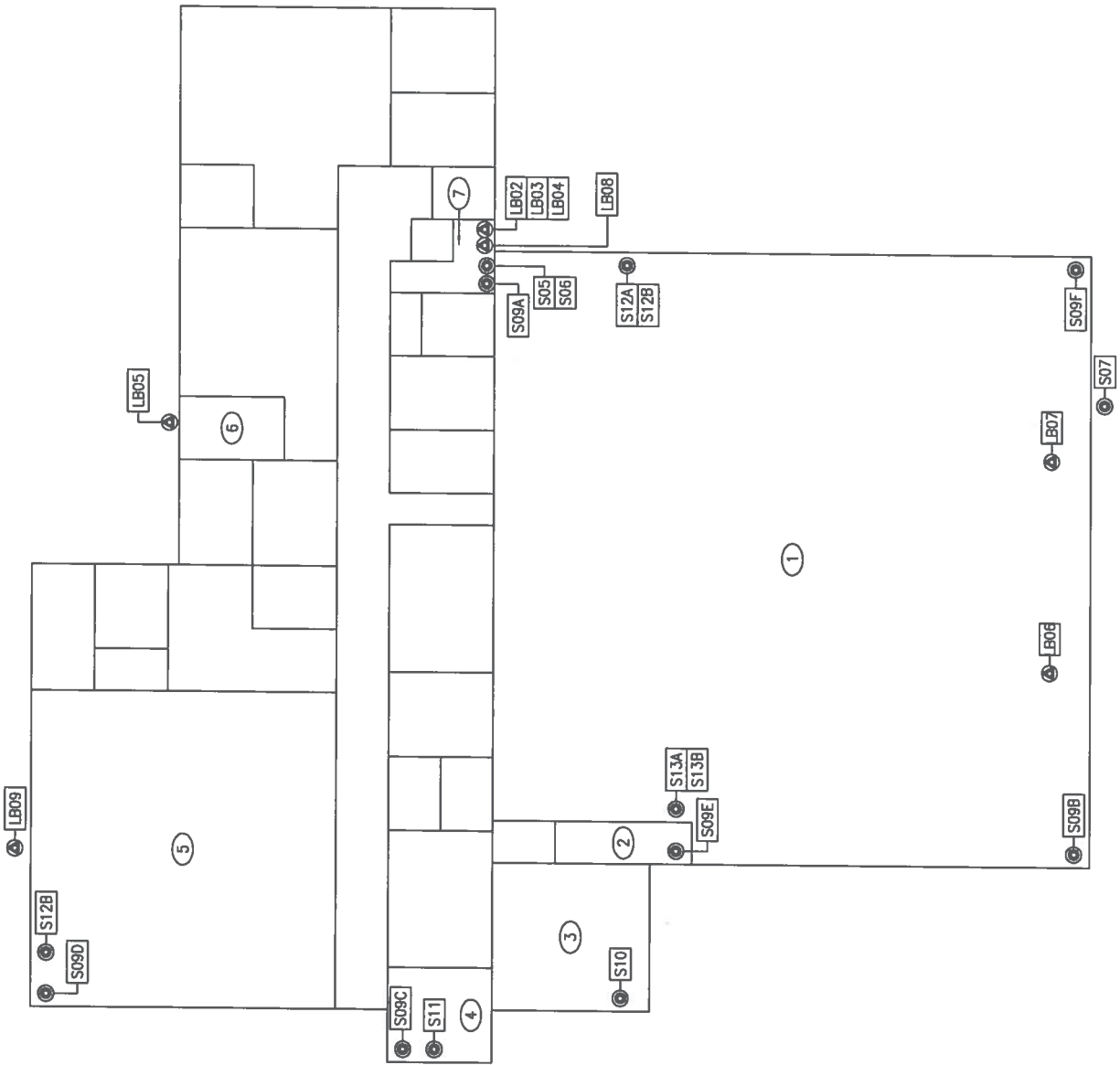
DRAWN BY:  
RJB

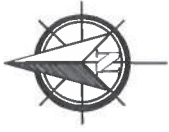
PROJECT NO:  
12166C

DATE:  
SEP 2011

CHECKED BY:  
HH

DRAWING NO:  
1 of 2





LEGEND

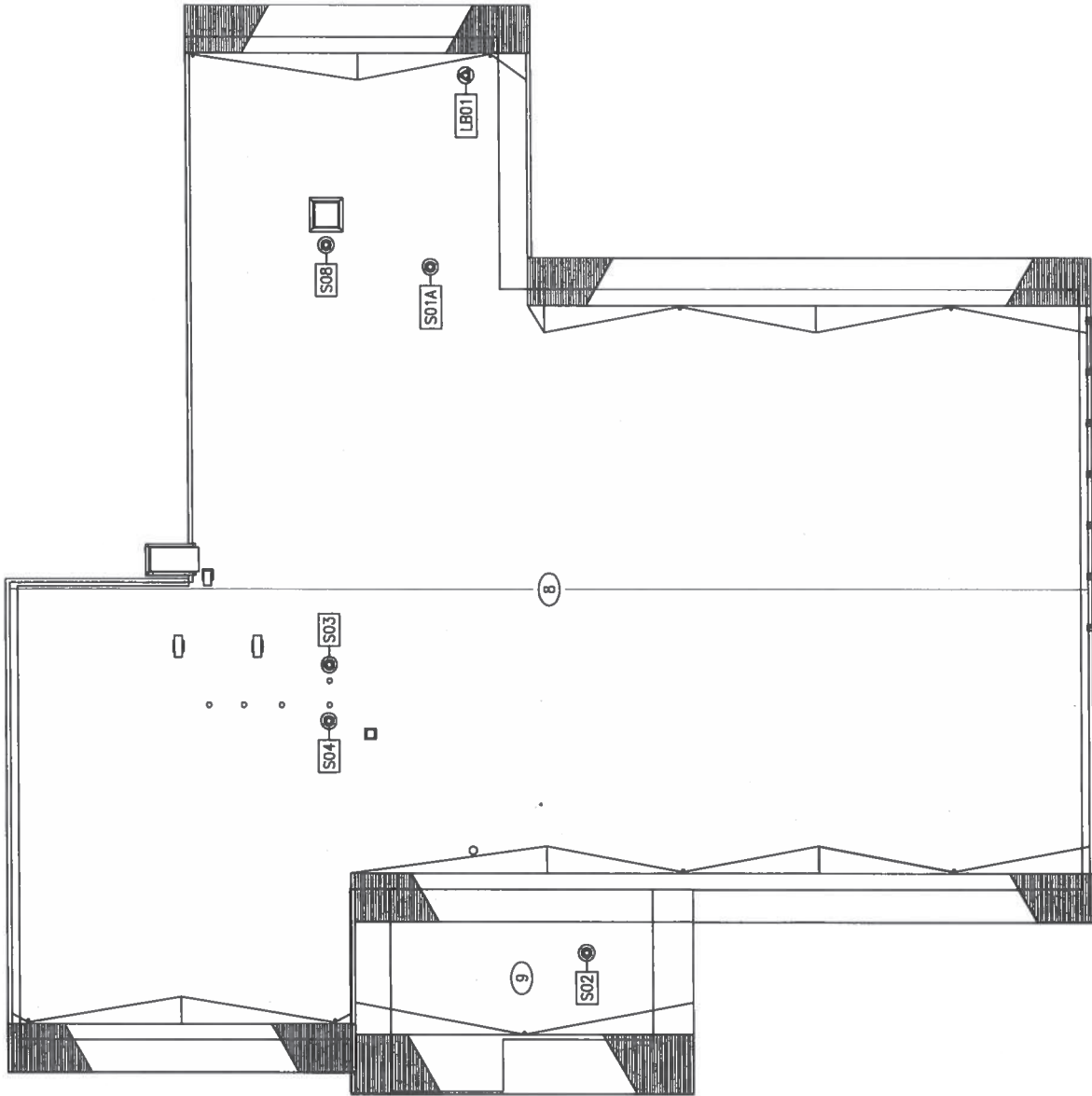
- XX LOCATION NUMBER
- ⊙ ASBESTOS BULK SAMPLE NUMBER
- ⊙ LEAD BULK SAMPLE NUMBER



CLIENT:  
PUBLIC WORKS AND  
GOVERNMENT SERVICES  
CANADA  
641 - 800 BURRARD STREET  
VANCOUVER, BC V6Z 2V8

DRAWING NAME:  
ROOF  
#18 COMBINED SERVICES BUILDING  
SANDSPIT, BC

SCALE: N.T.S.	DRAWN BY: RJB	PROJECT NO: 121666
DATE: SEP 2011	CHECKED BY: HN	DRAWING NO: 2 of 2



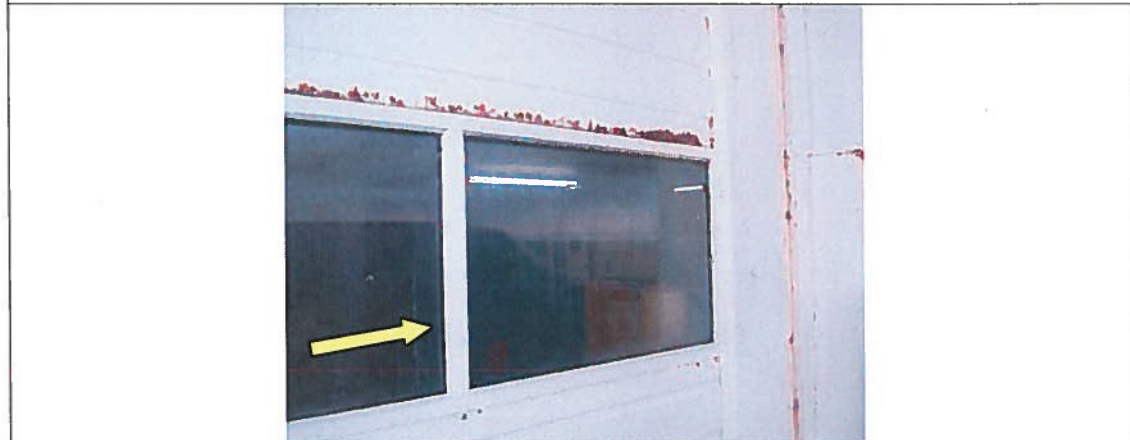


**APPENDIX IV**  
**PHOTOGRAPHS**

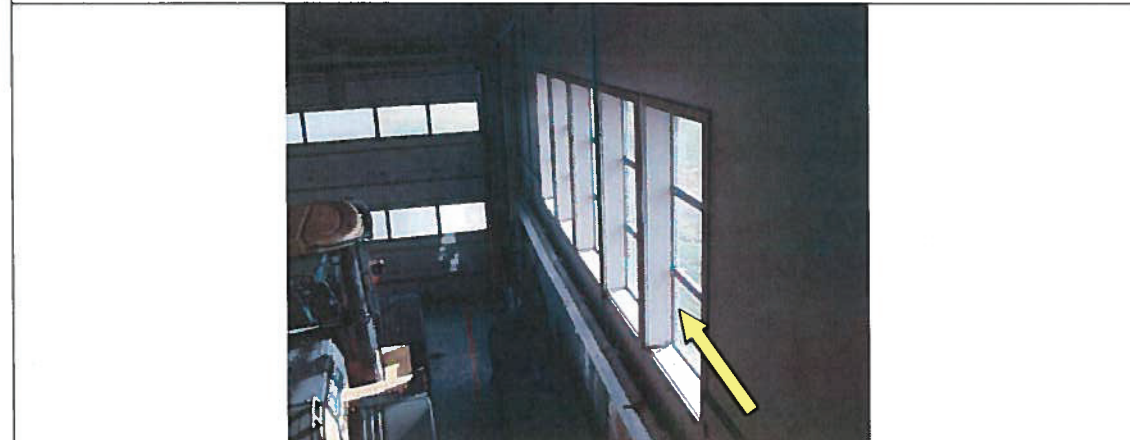




Typical asbestos-containing black window putty applied to glazing of the exterior man doors.



Typical asbestos-containing black window putty applied to glazing of the exterior overhead sectional doors.



Typical asbestos-containing black window putty applied to the glazing of windows on the North and South facades



**APPENDIX V**  
**SPECIFIC METHODOLOGIES**



### ASBESTOS-CONTAINING MATERIALS (ACMs)

Each room or area was categorized into system groups and was further sub-categorized into building materials suspected to contain asbestos as follows:

<b>Systems and Materials</b>	
Floor (e.g. floor tiles, vinyl sheet flooring)	Pipe (e.g. pipe insulation, insulating cement)
Ceiling (e.g. texture coat, ceiling tiles, drywall)	Duct (e.g. insulating cement)
Wall (e.g. drywall, plaster)	Mechanical (e.g. pre-formed insulation, insulating cement)
Structure (e.g. fireproofing, thermal insulation)	Miscellaneous (e.g. debris, cement board)

A separate set of samples was collected of each type of homogenous material suspected to contain asbestos. A homogenous material is defined as material that is uniform in texture and appearance, was installed at one time, and is unlikely to consist of more than one type or formulation of material. Samples were collected at a rate that was in compliance with the requirements of local regulations and guidelines. A sample log of homogeneous materials has been included in Appendix II-B.

The approximate quantity, location and sample locations of suspect ACMs were recorded. Available information on the phases of the construction/renovation and as-built drawings was utilized. Historical information on the use of asbestos in building materials and time frames for the likely presence of asbestos in these materials was taken into consideration.

All bulk samples were submitted to a National Voluntary Laboratory Accreditation Program (NVLAP) accredited laboratory for analysis. The asbestos analysis was completed using a stop positive approach. Stop positive means samples in a homogenous material sample set were analyzed consecutively and when a sample was identified as asbestos-containing, further sample analysis within that sample set was not completed.

**Table A - Definitions of Asbestos**

Jurisdiction	Percent of asbestos in material
British Columbia	1% (some material with <1% may still require special handling).

**LEAD IN PAINT**

Paints were either tested with a direct reading X-ray Fluorescence Analyzer (XRF) or by bulk sampling and laboratory analysis.

**Table B - Criteria for Lead in Paint**

Jurisdiction	Lead by Weight (%)	Lead by Weight (mg/kg)	Lead by Unit Area (mg/cm <sup>2</sup> )
British Columbia	0.06*	600*	0.08**
Alberta	0.5	5,000	1.0
Saskatchewan	0.5	5,000	1.0
Yukon	0.5	5,000	1.0
North West Territories	0.06	600	0.08**
Federal	0.5	5,000	1.0

\* Worksafe BC has adopted the position that the removal of paint with a lead concentration as low as 0.06% (600 mg/kg) by aggressive techniques (i.e. abrasive blasting) can approach the occupational exposure limit. Worksafe BC has also stated that lead concentrations as low as 0.009% (90 mg/kg) may present a risk to pregnant women and children.

\*\* Based on internal studies performed by PHH ARC.

**LEAD PRODUCTS**

Lead building products (e.g. batteries, lead sheeting, flashings) are assumed to contain lead and sampling for laboratory analysis was not performed. Glazing on ceramic tiles and pointing mortar on exterior masonry was tested by sampling and laboratory analysis.

**CRYSTALLINE SILICA**

Building materials suspected of containing crystalline silica (e.g. concrete, cement, tile, brick, masonry, mortar) were identified by knowledge of current and historic applications



and visual inspection only. Sampling of these materials for laboratory analysis of crystalline silica content was not performed.

### **MERCURY**

Building materials/products/equipment (e.g. thermostats, barometers, pressure gauges, light tubes), suspected to contain mercury were identified by visually inspection only. Sampling of these materials for laboratory analysis of mercury content was not performed.

### **POLYCHLORINATED BIPHENYLS (PCBs)**

Light ballast and wet transformers suspected to contain PCB's were determined based on the age of the building, a review of maintenance records and examination of labels on equipment where present and accessible. Light ballasts and wet transformers installed prior the manufacture end date (1980) of PCBs have been detailed in Section 4.0 of this report. Any light ballasts and wet transformers are presumed to be non-PCB if installed after the manufacture end date (1980). Dry transformers are presumed to be free of fluids and hence non-PCB. Sampling of suspect PCB-containing materials for laboratory analysis of PCB content was not performed.

### **HALOCARBONS**

Air conditioning units, chillers and fire suppression systems (fixed and portable) suspected of containing halocarbons was determined by visual inspection of manufactures labels and maintenance records only.

### **MOULD**

Building materials suspected of mould growth were determined through visual observation only. Suspect visible mould was quantified.



## **APPENDIX B**

Canadian Climate Normals - Sandspit





Canada

### Canadian Climate Normals 1971-2000

The minimum number of years used to calculate these Normals is indicated by a code for each element. A "+" beside an extreme date indicates that this date is the first occurrence of the extreme value. Values and dates in bold indicate all-time extremes for the location.

**NOTE!!** Data used in the calculation of these Normals may be subject to further quality assurance checks. This may result in minor changes to some values presented here.

**SANDSPIT A \***  
BRITISH COLUMBIA

Latitude: 53°15'14.000" N Longitude: 131°48'47.000" W Elevation: 6.40 m

Climate ID: 1057050

WMO ID:

IC ID: YZP

\* This station meets WMO standards for temperature and precipitation.

Temperature:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Daily Average (°C)	3.2	3.7	4.7	6.4	9	11.8	14.3	15	13.1	9.3	5.6	3.8	8.3	A
Standard Deviation	1.9	1.8	1.1	0.9	1	1.1	0.9	0.9	0.9	0.9	1.7	1.5	0.8	A
Daily Maximum (°C)	5.6	6.3	7.6	9.4	12	14.6	17	17.9	16	12.1	8.3	6.3	11.1	A
Daily Minimum (°C)	0.7	1.1	1.8	3.3	6	8.9	11.5	12.1	10.2	6.4	2.9	1.3	5.5	A
Extreme Maximum (°C)	12.4	13.4	13.9	18.9	21.7	25.9	<b>27.8</b>	26.7	24.1	20.6	16.3	13.4		
Date (yyyy/dd)	1981/18	1977/19	1965/12	1958/29	1958/25	1987/29	<b>1971/28</b>	1952/05	1980/15	1986/04	1985/02	1980/15		
Extreme Minimum (°C)	-13.9	-12.3	-12.2	-5.1	-1.1	2.2	5	1.9	-0.6	-3.1	<b>-15.5</b>	-12.8		
Date (yyyy/dd)	1954/26	1989/01	1951/05	1996/02	1965/04	1950/04	1971/01	1992/11	1948/22	1984/30	<b>1985/26</b>	1970/04		
<b>Precipitation:</b>														
Rainfall (mm)	148.8	123.1	107.2	99.9	63.2	56.2	46.7	57.5	83.7	185.5	195.6	174	1341.2	A
Snowfall (cm)	22.3	16	6.5	2	0	0	0	0	0	0	3.6	11.3	61.7	A
Precipitation (mm)	168.7	139	113.3	102	63.2	56.2	46.6	57.5	83.7	185.5	198.2	184.5	1398.2	A
Average Snow Depth (cm)	2	1	0	0	0	0	0	0	0	0	0	1	0	A
Median Snow Depth (cm)	1	0	0	0	0	0	0	0	0	0	0	0	0	A
Snow Depth at Month-end (cm)	2	2	0	0	0	0	0	0	0	0	0	1	0	A
Extreme Daily Rainfall (mm)	66.4	45.8	41.5	<b>79.5</b>	48.3	39.1	22.1	46.5	48.5	58.6	66.2	66.8		
Date (yyyy/dd)	2001/09	1983/09	1983/08	<b>1952/15</b>	1950/16	1973/11	1957/30	1991/29	1961/04	1978/31	1984/01	1991/20		
Extreme Daily Snowfall (cm)	<b>38</b>	27.4	19.6	8.6	1.5	0	0	0	0	2	22.9	23.4		
Date (yyyy/dd)	<b>1996/27</b>	1972/25	1951/05	1971/19	1962/01	1949/01	1949/01	1948/01	1945/01	1984/30	1964/27	1955/19		
Extreme Daily Precipitation (mm)	71.4	45.8	47.5	<b>79.5</b>	48.3	39.1	22.1	46.5	48.5	58.6	67	66.8		
Date (yyyy/dd)	2001/09	1983/09	1946/27	<b>1952/15</b>	1950/16	1973/11	1957/30	1991/29	1961/04	1978/31	1984/01	1991/20		
Extreme Snow Depth (cm)	<b>81</b>	66	30	3	0	0	0	0	0	1	28	43		
Date (yyyy/dd)	<b>1969/13</b>	1969/06	1972/01	1968/11	1955/01	1955/01	1955/01	1955/01	1955/01	1984/29	1964/28	1971/23		
<b>Days with Maximum Temperature:</b>														
<= 0 °C	1.9	0.97	0.10	0	0	0	0	0	0	0	0.44	1.3	4.7	A
> 0 °C	29.1	27.3	30.9	30	31	30	31	31	30	31	29.6	29.7	360.6	A

<b>Temperature:</b>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
> 10 °C	1.6	1.5	3	9.7	25.6	29.8	31	31	30	26	7	2.5	198.6	A
> 20 °C	0	0	0	0	0.14	0.67	2.9	4.4	0.93	0.07	0	0	9.1	A
> 30 °C	0	0	0	0	0	0	0	0	0	0	0	0	0	A
> 35 °C	0	0	0	0	0	0	0	0	0	0	0	0	0	A
<b>Days with Minimum Temperature:</b>														
> 0 °C	18.4	18	23.4	27.3	30.9	30	31	31	30	30.8	25.2	21.5	317.4	A
<= 2 °C	19.9	16.7	16.8	9.6	1.2	0	0	0.03	0	1.5	11	18.8	95.5	A
<= 0 °C	12.6	10.3	7.6	2.7	0.07	0	0	0	0	0.21	4.8	9.6	47.9	A
< -2 °C	5.9	4.1	1.8	0.28	0	0	0	0	0	0	1.6	3.8	17.4	A
< -10 °C	0.10	0.14	0	0	0	0	0	0	0	0	0.07	0.10	0.41	A
< -20 °C	0	0	0	0	0	0	0	0	0	0	0	0	0	A
< -30 °C	0	0	0	0	0	0	0	0	0	0	0	0	0	A
<b>Days with Rainfall:</b>														
>= 0.2 mm	19.6	17.6	20.1	19.6	17.7	16	14.1	13.9	16.9	22.6	23	21.3	222.3	A
>= 5 mm	9.3	7.8	7.5	6.6	4.2	3.6	3.2	4	5.7	11.8	11.9	11.3	86.7	A
>= 10 mm	4.9	4.5	3.6	3.1	1.3	1.2	0.90	1.4	2.3	6.3	7	6.4	42.7	A
>= 25 mm	1.1	0.93	0.21	0.41	0.14	0.03	0	0.10	0.34	1.4	1.4	1.3	7.4	A
<b>Days With Snowfall:</b>														
>= 0.2 cm	5.5	4.4	2.9	1.3	0.07	0	0	0	0	0.07	1.7	2.9	18.8	A
>= 5 cm	1.5	1	0.28	0.10	0	0	0	0	0	0	0.22	0.75	3.9	A
>= 10 cm	0.55	0.31	0.07	0	0	0	0	0	0	0	0.04	0.21	1.2	A
>= 25 cm	0.03	0.03	0	0	0	0	0	0	0	0	0	0	0.06	A
<b>Days with Precipitation:</b>														
>= 0.2 mm	22.3	19.7	20.7	19.8	17.8	16	14.1	13.8	16.9	22.6	23.7	22.8	230.2	A
>= 5 mm	10.8	8.8	8	6.7	4.2	3.6	3.2	4	5.7	11.8	12.2	12.2	91.2	A
>= 10 mm	5.6	4.9	3.7	3.1	1.3	1.2	0.90	1.4	2.3	6.3	7	6.8	44.5	A
>= 25 mm	1.2	1	0.28	0.41	0.14	0.03	0	0.10	0.34	1.4	1.4	1.3	7.6	A
<b>Days with Snow Depth:</b>														
>= 1 cm	5.5	4.7	1.3	0.03	0	0	0	0	0	0	0.48	2.8	14.8	A
>= 5 cm	4	2.9	0.82	0	0	0	0	0	0	0	0.11	1.7	9.5	A
>= 10 cm	2.2	1.4	0.43	0	0	0	0	0	0	0	0	0.92	5	A
>= 20 cm	0.48	0.25	0.14	0	0	0	0	0	0	0	0	0.50	1.4	A
<b>Wind:</b>														
Speed (km/h)	21.6	21.1	20	20.5	19.3	17.7	16.4	16	17.2	19.9	21.4	21.4	19.4	A
Most Frequent Direction	SE	SE	SE	SE	SE	SE	W	W	SE	SE	SE	SE	SE	A
Maximum Hourly Speed (km/h)	129	105	100	113	97	77	74	74	93	137	121	121		
Date (yyyy/dd)	1955/03	1974/20	1981/24	1954/08	1954/30	1965/10	1993/21	1991/29	1962/27	1954/20	1954/12	1954/08		
Maximum Gust Speed (km/h)	161	164	121	140	122	97	93	100	113	148	161	152		
Date (yyyy/dd)	1955/03	1974/20	1970/12	1960/16	1987/29	1956/21	1982/05	1991/29	1958/24	1977/24	1959/01	1981/04		
Direction of Maximum Gust	SE	SE	SE	SE	E	SE	SE	E	SE	E	SW	SE	SE	
Days with Winds >= 52 km/h	7.3	5.9	5.1	4.4	2.8	1.4	0.8	0.9	2.1	5.2	7.4	7.1	50.5	C
Days with Winds >= 63 km/h	3.4	3	2.7	2	0.9	0.3	0.2	0.3	1	2.4	3.8	3.6	23.4	C
<b>Degree Days:</b>														
Above 24 °C	0	0	0	0	0	0	0	0	0	0	0	0	0	A
Above 18 °C	0	0	0	0	0	0.2	1.3	1.9	0.2	0	0	0	3.6	A
Above 15 °C	0	0	0	0	0.1	1.7	11.8	21.2	5.2	0.2	0	0	40.2	A
Above 10 °C	0	0	0	0.7	11.9	56.3	131.9	154.2	94.8	18.8	1.2	0	469.8	A
Above 5 °C	16.1	15.6	20.9	48.3	125.1	202.9	286.8	309.2	243	134.2	42.3	17.6	1462	A
Above 0 °C	110.3	111.7	146.8	190.7	280	352.9	441.8	464.2	393	288.5	171.2	125.3	3076.4	A
Below 0 °C	11.9	6	1	0	0	0	0	0	0	0	3	6.9	28.8	A
Below 5 °C	72.7	51.3	30	7.5	0.2	0	0	0	0	0.7	24.1	54.2	240.7	A
Below 10 °C	211.6	177.1	164.1	110	41.9	3.4	0.1	0	1.7	40.2	133	191.7	1074.9	A
Below 15 °C	366.6	318.5	319.1	259.3	185.2	98.9	35	22	62.1	176.6	281.8	346.7	2471.7	A
Below 18 °C	459.6	403.3	412.1	349.3	278	187.4	117.5	95.7	147.1	269.5	371.8	439.7	3530.9	A
<b>Bright Sunshine:</b>														
Total Hours	48.6	78.1	118.1	154.6	199.1	176.8	186.6	186.8	141.8	97.9	63	47	1498.1	C
Days with measureable	18.9	20.8	25.7	26.6	28.7	27.2	28	28.3	25.8	24.2	20.2	18.9	293.2	C

<u>Temperature:</u>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
% of possible daylight hours	19.3	28.2	32.2	36.9	40.5	34.9	36.7	40.8	37.1	29.7	24.1	19.9	31.7	C
Extreme Daily	7.6	9.8	11.5	14.1	15.9	17	16.5	15.2	12.9	10.6	8.3	6.6		C
Date (yyyy/dd)	1972/26	1991/28	1994/28	1979/27	1982/28	1976/06	1994/04	1977/03	1993/02	1994/14	1994/01	1972/05		
<u>Humidex:</u>														
Extreme Humidex	13.8	13.4	12.8	17.8	23	28.4	30.8	30.2	27.6	24.5	17.9	15		
Date (yyyy/dd)	1963/06	1977/19	1965/10	1958/29	1998/27	1987/29	1971/28	1997/13	1980/15	1986/04	1986/02	1980/14		
Days with Humidex >= 30	0	0	0	0	0	0	0	0	0	0	0	0	0.1	A
Days with Humidex >= 35	0	0	0	0	0	0	0	0	0	0	0	0	0	A
Days with Humidex >= 40	0	0	0	0	0	0	0	0	0	0	0	0	0	A
<u>Wind Chill:</u>														
Extreme Wind Chill	-22.9	-24.1	-22.9	-10.8	-4.2	-0.2	3.8	4	0.7	-10.7	-26	-20.8		
Date (yyyy/dd)	1971/10	1989/01	1955/02	1954/03	1964/12	1973/01	1971/01	1969/19	1958/21	1984/30	1985/26	1964/15		
Days with Wind Chill < -20	0.2	0.1	0	0	0	0	0	0	0	0	0.1	0	0.4	A
Days with Wind Chill < -30	0	0	0	0	0	0	0	0	0	0	0	0	0	A
Days with Wind Chill < -40	0	0	0	0	0	0	0	0	0	0	0	0	0	A
<u>Humidity:</u>														
Average Vapour Pressure (kPa)	0.7	0.7	0.7	0.8	0.9	1.1	1.3	1.4	1.2	1	0.8	0.7	1	A
Average Relative Humidity - 0600LST (%)	87.5	87	86.7	86.6	84.6	84.5	84.9	85.3	86.2	87.2	86.8	86.9	86.2	A
Average Relative Humidity - 1500LST (%)	83.4	80	77.1	76.7	75.3	76.7	76.3	76.2	76.3	78.5	80.9	83.7	78.4	A
<u>Pressure:</u>														
Average Station Pressure (kPa)	101	100.9	101	101.3	101.5	101.6	101.8	101.6	101.5	101.2	100.8	101	101.2	A
Average Sea Level Pressure (kPa)	101	100.9	101.1	101.3	101.5	101.6	101.8	101.7	101.6	101.2	100.9	101	101.3	A
<u>Radiation:</u>														
Extreme Global - RF1 (MJ/m2)	6.5	12	18.9	26.7	30	31.6	31	27.5	20.7	13	7.2	4.1		
Date (yyyy/dd)	1974/29	1978/27	1987/30	1988/30	1986/31	1976/12	1972/01	1977/03	1985/01	1985/06	1967/03	1985/01		
<u>Visibility (hours with):</u>														
< 1 km	10.8	9.5	3.8	4.6	2.2	2.7	2.5	3.7	6.2	4.7	2.7	5.5	58.9	C
1 to 9 km	81.7	74	57.5	46.1	32.8	30.2	29.2	28	33.5	65.4	65.9	77.6	621.9	C
> 9 km	651.4	595.6	682.7	669.4	709	687	712.4	712.3	680.3	673.9	651.4	660.9	8086.3	C
<u>Cloud Amount (hours with):</u>														
0 to 2 tenths	95.5	101.3	116.8	115.7	114.9	86.2	110.7	145	151.3	109.2	98.6	96.3	1341.5	D
3 to 7 tenths	137.1	133.3	169.8	165	172.1	150.9	150.4	154.6	167	172.2	166.6	154.6	1893.5	D
8 to 10 tenths	511.5	443.4	457.4	439.3	457	482.9	483	444.4	401.7	462.6	454.8	493.1	5531	D

We'd like to hear from you! Please click ["Contact Us"](#) to share your comments and suggestions.

Date Modified: 2011-09-14



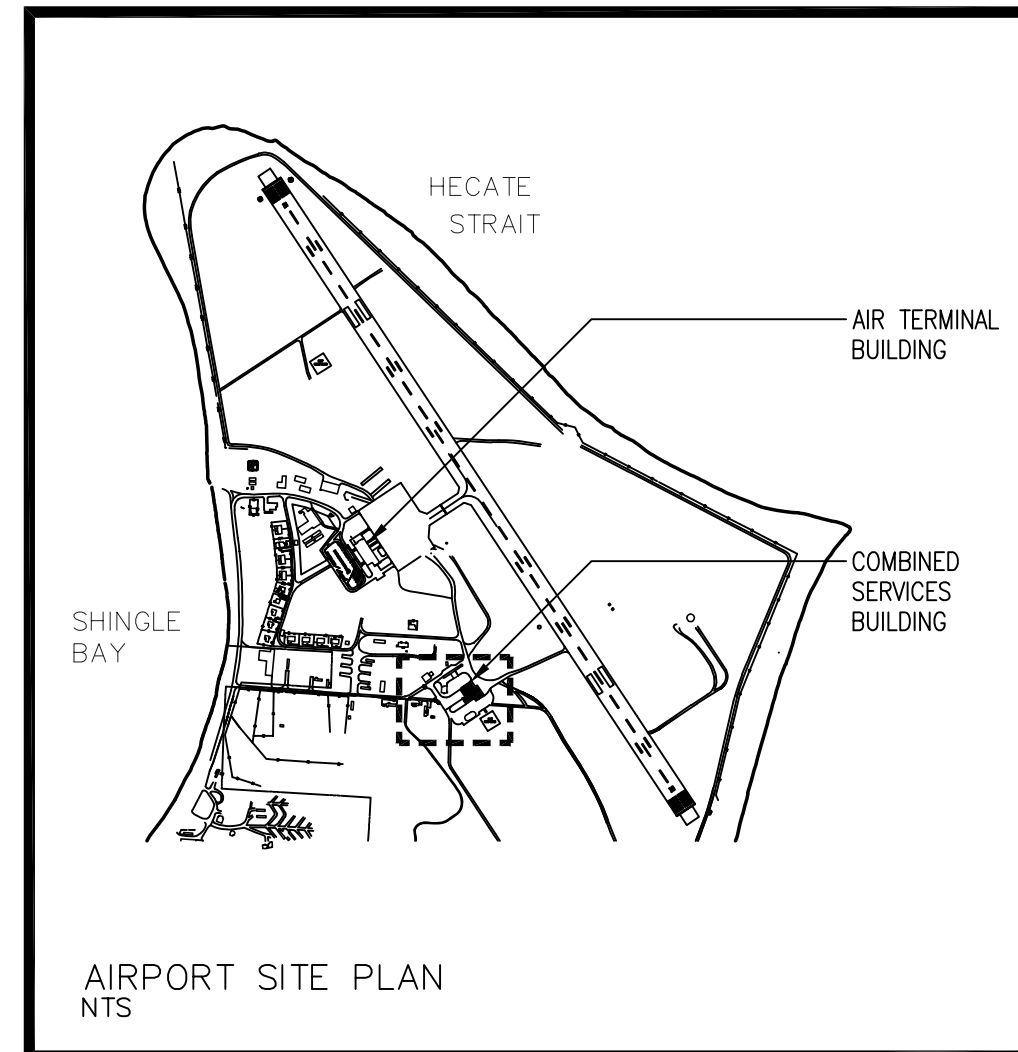


# Transport Canada Sandspit Airport HVAC Rehabilitation

J M BEAN & CO. LTD

Consulting Mechanical Engineers

PROJECT NUMBER: 1525.00



MECHANICAL DRAWING LIST	
M-1	DRAWING LIST, LEGEND, GENERAL NOTES, AND ABBREVIATIONS. - HVAC
M-2	MAIN FLOOR DEMOLITION PLAN - HVAC
M-3	MAIN FLOOR NEW CONSTRUCTION PLAN AND PARTIAL PIPING SCHEMATIC - HVAC
M-4	SECOND FLOOR DEMOLITION PLAN AND SELECT SCHEDULES - HVAC
M-5	SECOND FLOOR NEW CONSTRUCTION PLAN, PARTIAL PIPING SCHEMATIC, AND SELECT SCHEDULES - HVAC
M-6	ROOF DEMOLITION PLAN, NEW CONSTRUCTION PLAN, AND DETAILS - HVAC
M-7	EXISTING SYSTEM DESCRIPTION - HVAC

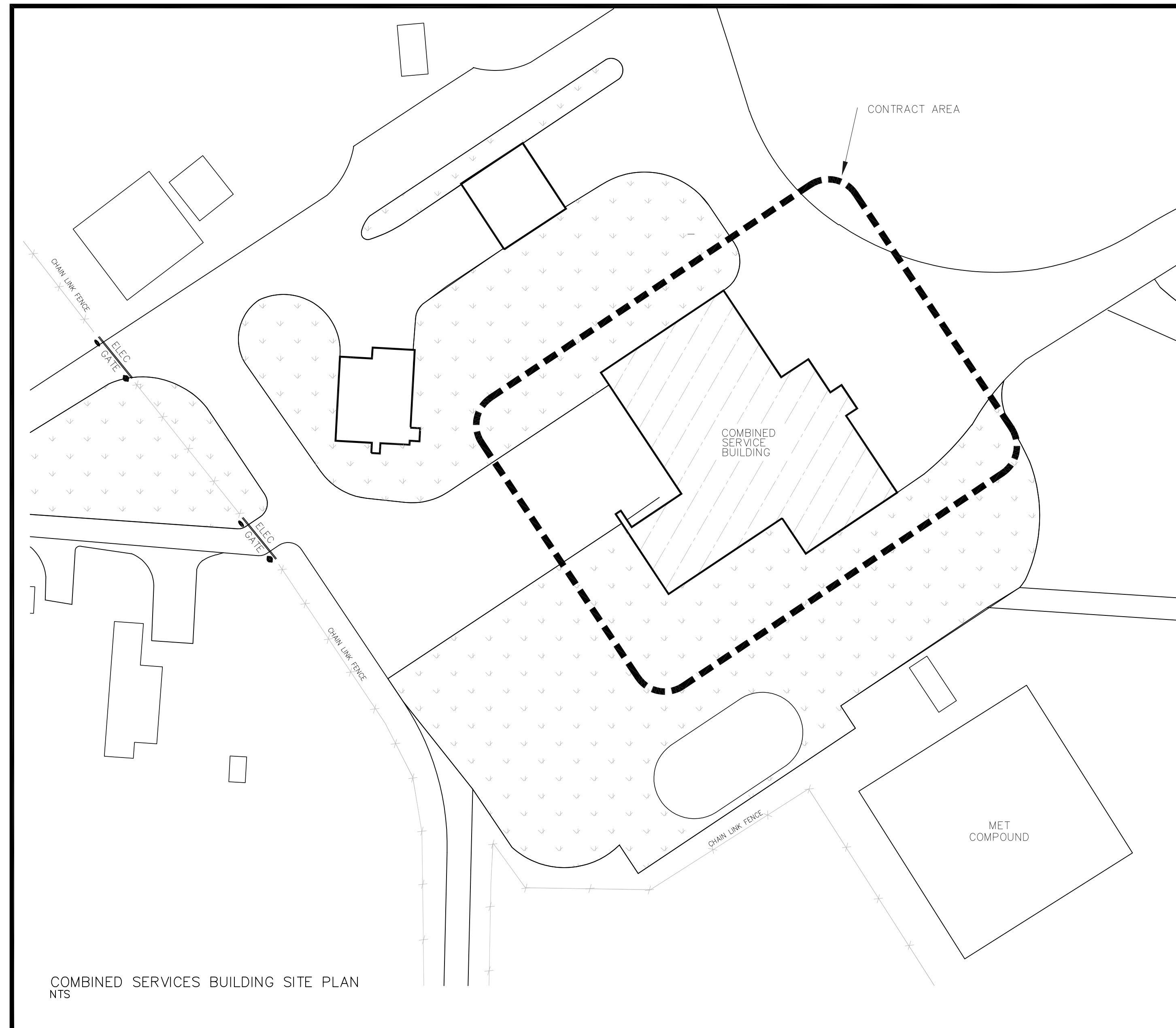
  

ELECTRICAL DRAWING LIST	
E-1	ELECTRICAL MAIN FLOOR PLAN
E-2	ELECTRICAL SECOND FLOOR PLAN

GENERAL NOTES	
1.	FLUSH, AND PROVIDE CHEMICAL TREATMENT, FOR HOT WATER HEATING SYSTEM. REMOVE AND CLEAN ALL STRAINERS ASSOCIATED WITH HOT WATER PIPING. REFER TO SPECIFICATION FOR DETAILS
2.	CLEAN ALL EXISTING S/A, E/A, O/A, T/A DUCTWORK AND ALL EXISTING FIRE DAMPERS. TRIP TEST FIRE DAMPERS AFTER CLEANING. REFER TO DRAWING M-7 FOR EXISTING HVAC SYSTEM LAYOUT. REFER TO SPECIFICATION FOR DETAILS ON CLEANING.
3.	ALL EXISTING DDC TEMPERATURE SENSORS TO REMAIN.
4.	ALL EXISTING PIPE SIZES ARE TAKEN FROM RECORD DRAWINGS. CONTRACTOR TO CONFIRM ON SITE ALL PIPE SIZES AS REQUIRED FOR THEIR SCOPE OF WORK.
5.	CONTRACTOR TO CONFIRM EXISTING MOTORIZED DAMPERS' SIZES ON-SITE PRIOR TO ORDERING NEW DAMPERS.
6.	TRANSPORT CANADA WILL PROVIDE, ON-SITE, EXTERIOR SPACE FOR OUTSIDE EQUIPMENT/MATERIAL/STORAGE TRAILER/SEACAN, AS REQUIRED BY THE CONTRACTOR.

HVAC LEGEND		HVAC LEGEND		HVAC LEGEND	
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	EX. DUCTWORK		FIRE DAMPER IN HORIZONTAL SEPERATION		PIPE CAP
	DUCTWORK		MANUAL WALL SWITCH		2-WAY CONTROL VALVE (2 POSITION)
	EX. FLEXIBLE DUCTWORK		THERMOSTAT		3-WAY CONTROL VALVE (2 POSITION)
	FLEXIBLE DUCTWORK		PUMP		EXISTING DOOR GRILLE
	SUPPLY DUCT RISER/SECTION		DRAIN		DOOR GRILLE (SIZE AS SCHEDULED)
	RETURN/EXHAUST DUCT RISER/SECTION		PRESSURE REDUCING VALVE		REMOVE EXISTING
	OUTDOOR AIR DUCT RISER/SECTION		PRESSURE GAUGE		HOT WATER SUPPLY
	DUCTWORK C/W 50mm THERMAL INSULATION		THERMOMETER		EX. HOT WATER RETURN
	DUCTWORK C/W 25mm ACOUSTIC INSULATION		THERMOMETER WELL		HOT WATER RETURN
	DUCTWORK C/W 50mm ACOUSTIC INSULATION		GLOBE VALVE		EQUIPMENT TAG
	ROUND DUCT RISER		ANGLE GLOBE VALVE		POINT OF DISCONNECTION
	ROUND DUCT DROP		STRAINER		POINT OF CONNECTION
	SUPPLY AIRFLOW DIRECTION		FLOW MEASUREMENT VALVE		AIR DISTRIBUTION TAG
	RETURN/EXHAUST AIRFLOW DIRECTION		GATE VALVE		
	BUILDING INTAKE/EXHAUST AIRFLOW DIRECTION		UNION		
	VOLUME DAMPER		CALIBRATED BALANCE VALVE		
	FIRE DAMPER IN VERTICAL SEPERATION		CHECK VALVE		
			PETE'S PLUG		
			PIPE FLANGE		

ABBREVIATIONS		ABBREVIATIONS		ABBREVIATIONS	
ABBREVIATION	DESCRIPTION	ABBREVIATION	DESCRIPTION	ABBREVIATION	DESCRIPTION
AHU	AIR HANDLING UNIT	HWR	HOT WATER RETURN	T/A	TRANSFER AIR
B	BOILER	HWS	HOT WATER SUPPLY	TYP.	TYPICAL
C/W	COMPLETE WITH	IR	INFRARED	UH	UNIT HEATER
DDC	DIRECT DIGITAL CONTROLS	O/A	OUTSIDE AIR	U/S	UNDERSIDE
E/A	EXHAUST AIR	P	PUMP		
EF	EXHAUST FAN	RE & RE	REMOVE AND REINSTALL		
EX	EXISTING	RF	RETURN FAN		
HC	HEATING COIL	S/A	SUPPLY AIR		



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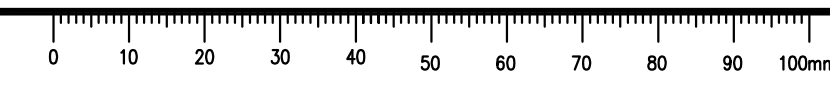
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**TRANSPORT CANADA**

Project title/Titre du projet  
**SANDSPIT, B.C.**  
TRANSPORT CANADA SANDSPIT AIRPORT  
COMBINED SERVICES BUILDING (CSB)  
HVAC REHABILITATION

Consultant Signature Only  
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PREETIPAL PAUL

Drawing title/Titre du dessin  
**DRAWING LIST, LEGEND,  
GENERAL NOTES, AND  
ABBREVIATIONS, - HVAC**

Project No./No. du projet  
R.077014.001  
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**M-1**  
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Le Révision  
no.  
1





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Drawing title/Titre du dessin

MAIN FLOOR DEMOLITION  
PLAN - HVAC

Project No./No. du  
projet  
R.077014.001

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of 7

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La Révision  
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DRAWING M-2 NOTES:

- M2.1 EXISTING 350X350 EXHAUST DUCT UP THRU MEZZANINE (201) TO ROOF MOUNTED EXHAUST FAN EF-5 C/W FIRE DAMPER @ FLOOR ABOVE. DUCTING TO REMAIN. ROOF MOUNT EXHAUST FAN (EF-5) TO BE REPLACED WITH NEW EXPLOSION PROOF EXHAUST FAN. EXISTING DUCT CONSISTS OF A 305X305 FRAME & A 152 # STUBOUT C/W A BLADE DAMPER. REMOVE EX. BLADE DAMPER. REFER TO FIGURE 5 ON M-2.
- M2.2 EXISTING HWS&R RISERS UP TO SECOND FLOOR WALL FIN RADIATOR.
- M2.3 REMOVE AND REPLACE EXISTING THERMOSTATS. REFER TO FIGURE 1 AND FIGURE 4 ON M-2.
- M2.4 REMOVE AND REPLACE EXISTING CONTROL VALVES. REFER TO FIGURE 2 & FIGURE 3 ON M-2.
- M2.5 EX. 350X200 DUCT UP TO WASHROOM EXHAUST FAN (EF-4).
- M2.6 EX. 305X305 DOOR GRILLE TO REMAIN. DOOR HAS UNDERCUT OF 25.
- M2.7 UNDERCUT OF 25.
- M2.8 REMOVE AND REPLACE EXISTING WALL SWITCH.



FIGURE 1: EXISTING THERMOSTAT UNIT DEMOLITION - OFFICE 123. TYPICAL OF 9.

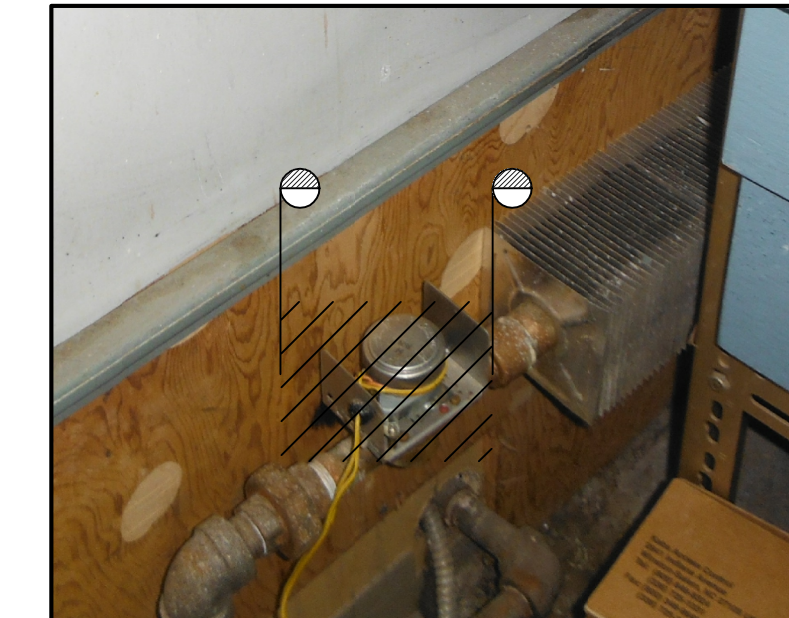


FIGURE 2: EXISTING 2-WAY CONTROL VALVE AND POINTS OF DISCONNECTION - FIELD TOOLS 119. TYPICAL OF 15.

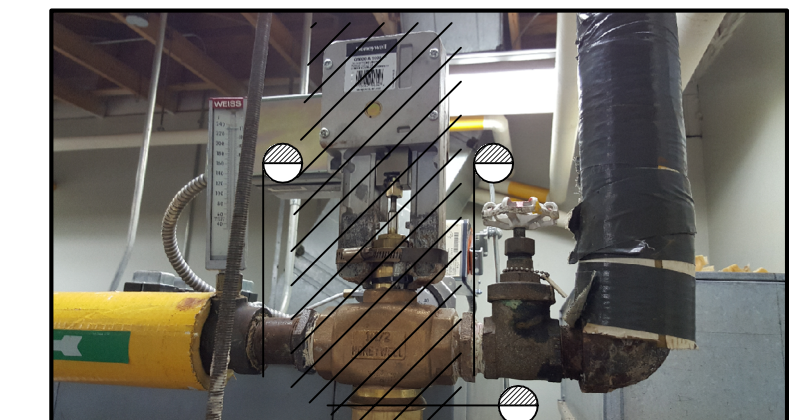


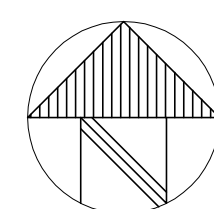
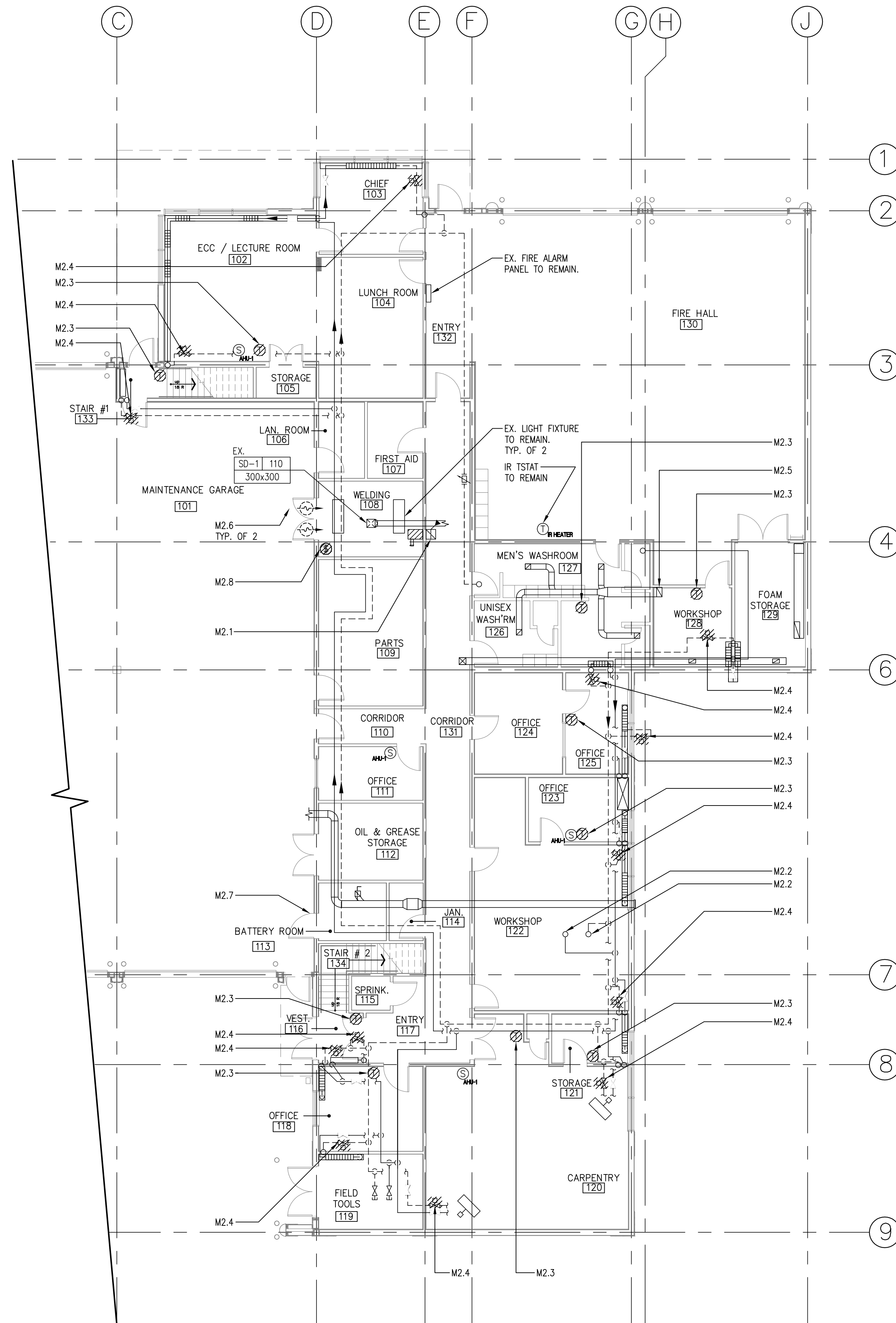
FIGURE 3: EXISTING 3-WAY CONTROL VALVE AND POINTS OF DISCONNECTION - MECHANICAL ROOM 205.



FIGURE 4: EXISTING THERMOSTAT TO BE REMOVED - CARPENTRY WORKSHOP 120.



FIGURE 5: EXISTING BLADE DAMPER TO BE REMOVED - WELDING ROOM 108.



MAIN FLOOR DEMOLITION PLAN - HVAC  
1:100



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**HVAC REHABILITATION**

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Drawing title/Titre du dessin  
**MAIN FLOOR NEW CONSTRUCTION PLAN AND PARTIAL PIPING SCHEMATIC - HVAC**

Project No./No. du projet R.077014.001	Sheet/Fauille <b>M-3</b> of 7	Revision no./Révision no. 1
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**DRAWING M-3 NOTES:**

- M3.1 PROVIDE NEW THERMOSTAT.
- M3.2 PROVIDE NEW EXHAUST SYSTEM FOR WELDING ROOM (108). ROOF TOP EXHAUST FAN IS TO BE EXPLOSION PROOF. DESIGN WAS BASED ON NEDERMAN EXTRACTION ARM. EXHAUST FAN IS TO PROVIDE AN EXHAUST RATE OF 565 L/S. THIS COMPRISES 330 L/S FOR GENERAL VENTILATION AND 235 L/S FOR THE EXTRACTION ARM. REFER TO FIGURE 6 AND FIGURE 7 ON M-3. TELESCOPIC EXTRACTION ARM SHALL BE PROVIDED WITH WALL BRACKET AND METAL HOOD C/W DAMPER. COORDINATE EXACT LOCATION, ON SITE, WITH DEPARTMENTAL REPRESENTATIVE.
- M3.3 PROVIDE NEW CONTROL VALVE.
- M3.4 PROVIDE NEW EXHAUST FAN, EXHAUST REGISTER, 203x203 DUCT UP, AND GOOSENECK DISCHARGE AT ROOF LEVEL. EXHAUST FAN IS TO HAVE AN EXHAUST RATE OF 94 L/S. EXHAUST FAN IS TO BE MOUNTED AT MEZZANINE (201) LEVEL. REFER TO DRAWING M-5 FOR LOCATION.
- M3.5 PROVIDE NEW EXHAUST FAN CONTROL SWITCH.
- M3.6 EXISTING DDC SENSOR TO REMAIN.
- M3.7 EXTEND EXISTING DUCTWORK AS SHOWN IN FIGURE 6 ON M-3. PROVIDE NEW EXHAUST GRILLE AS SPECIFIED.
- M3.8 CONNECT NEW TELESCOPIC FUME EXTRACTION ARM TO EXISTING 152# DUCT. EXTEND EXISTING 152# SUFFICIENTLY TO ALLOW FOR POSITIONING OF NEW TELESCOPIC FUME EXTRACTION ARM OVER EXISTING WELDING TABLE. REFER TO FIGURE 6 ON M-3.
- M3.9 152 # DUCT UP TO GOOSENECK DISCHARGE AT ROOF LEVEL. PROVIDE NEW IN LINE EXHAUST FAN (EF-9). MOUNT EXHAUST FAN, EXPOSED, IN CEILING SPACE OF CARPENTRY (120) ROOM. REFER TO M-5 FOR MOUNTING LOCATION.

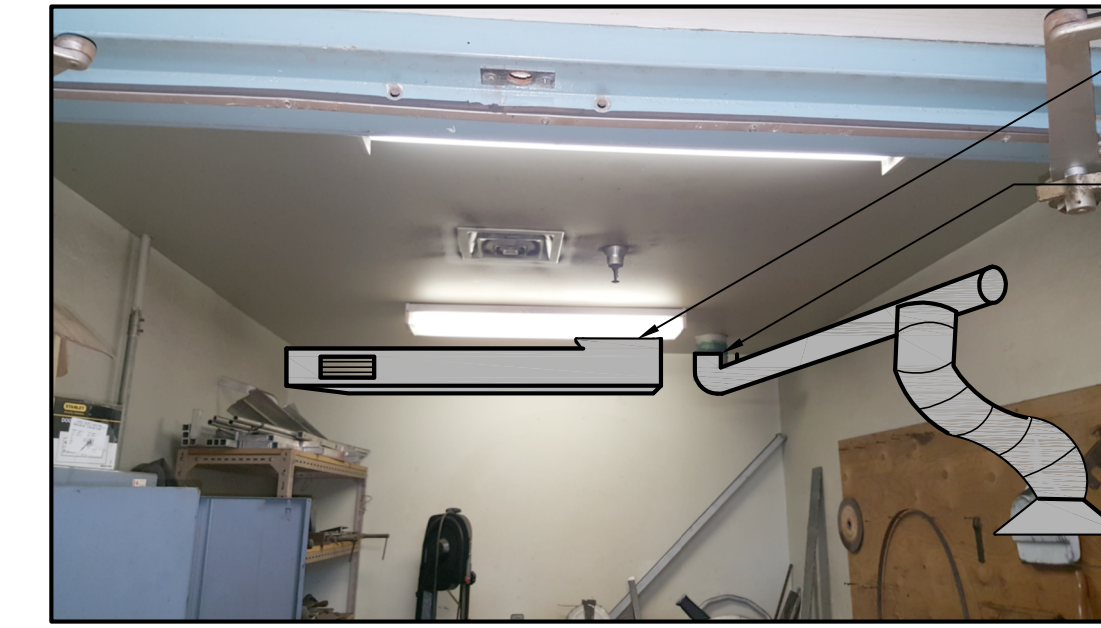


FIGURE 6: EXISTING DUCTWORK TO BE USED FOR CONNECTION TO WELDING EXHAUST - WELDING ROOM 108.

CONNECT NEW 508x305 DUCTWORK TO EX. 305x305 DUCT FRAME. RUN TIGHT TO U/S OF CEILING. PROVIDE NEW EXHAUST GRILLE AS SPECIFIED.  
CONNECT NEW EXTRACTION ARM TO EX. 152 # STUBOUT. REFER TO NOTE M3.2 ON DRAWING M-3 AND SPECIFICATIONS FOR DETAILS.  
NOTE: REMOVE EX. BLADE DAMPER PRIOR TO CONNECTION OF NEW EXTRACTION ARM.

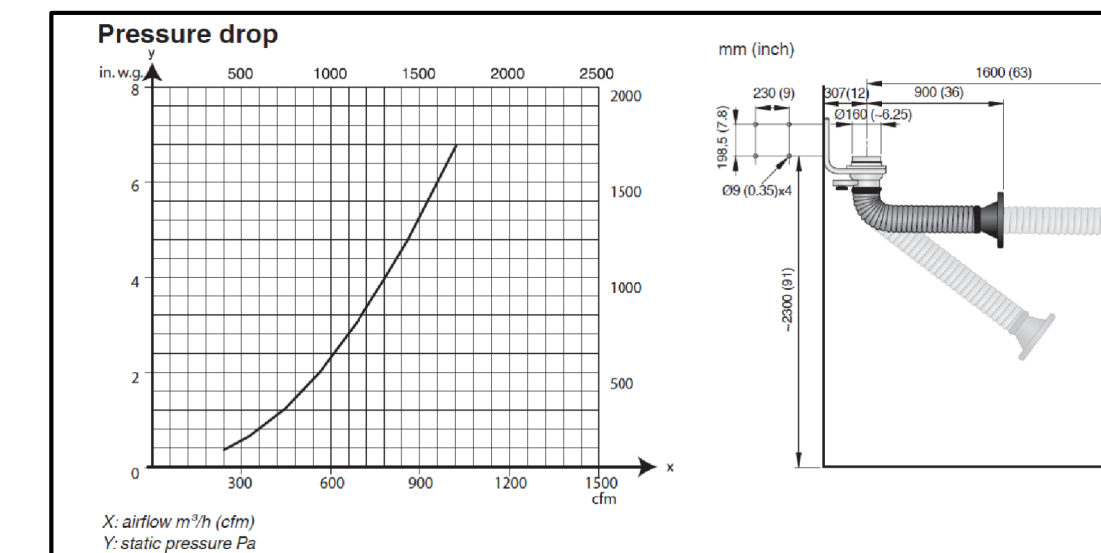
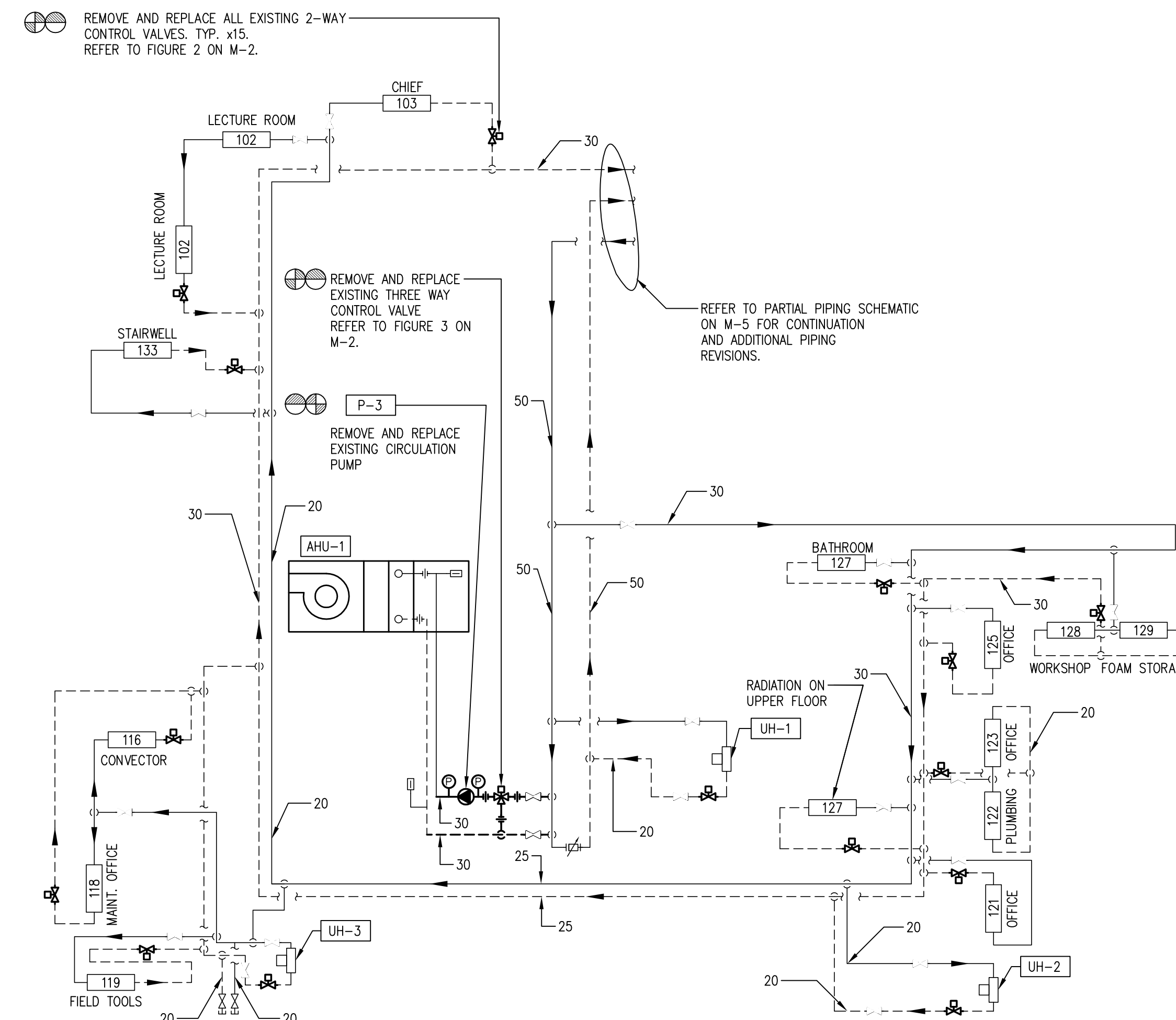
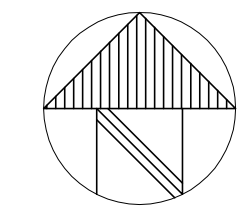
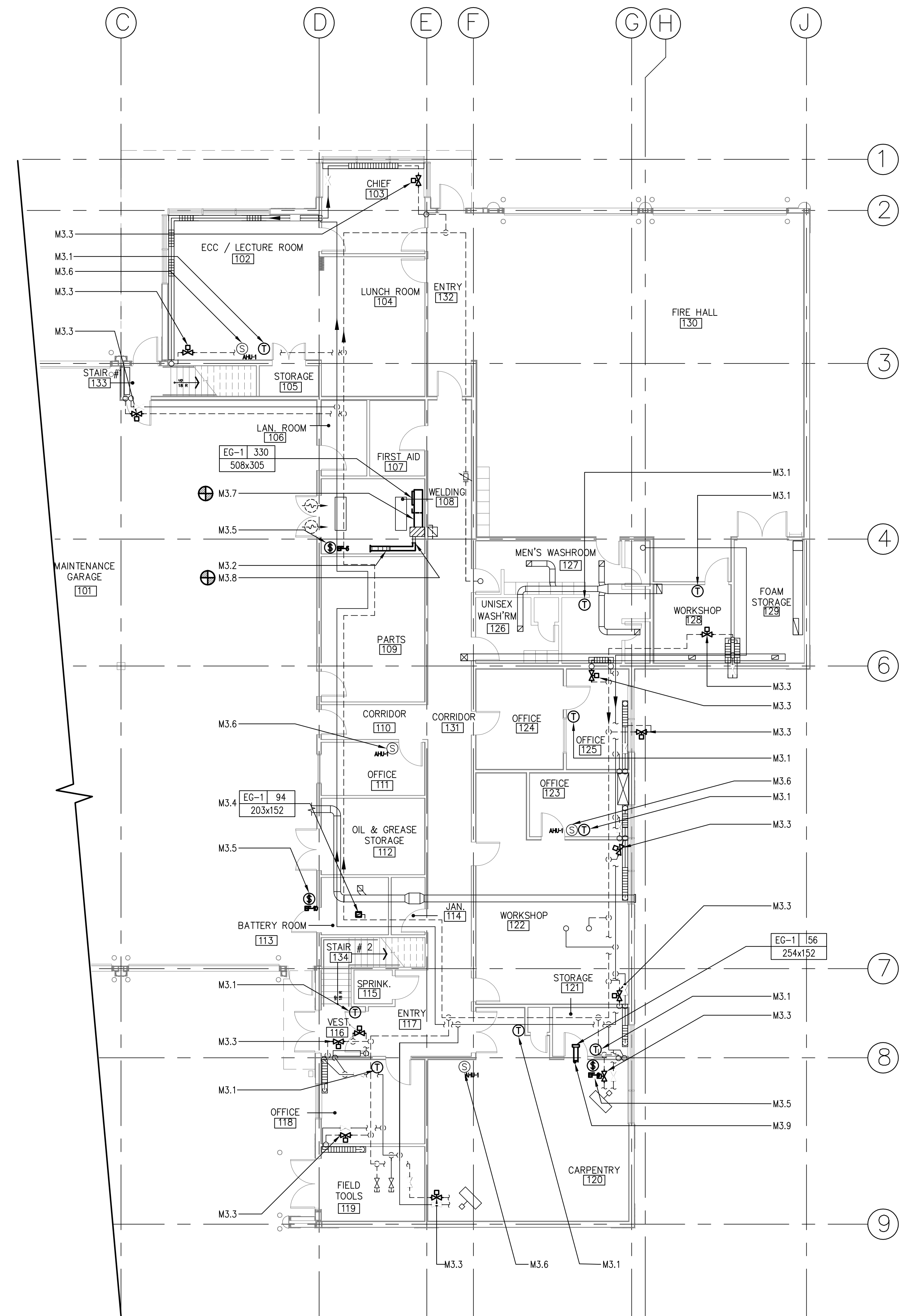


FIGURE 7: DESIGN BASIS EXTRACTION ARM TECHNICAL INFORMATION.

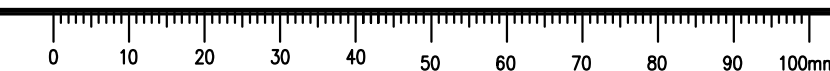


PARTIAL PIPING SCHEMATIC N.T.S.

ALL EXISTING PIPE SIZES ARE TAKEN FROM RECORD DRAWINGS. CONTRACTOR TO CONFIRM ON SITE ALL PIPE SIZES AS REQUIRED FOR THEIR SCOPE OF WORK.



MAIN FLOOR NEW CONSTRUCTION PLAN - HVAC  
1:100





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TRANSPORT CANADA

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SANDSPIT, B.C.

TRANSPORT CANADA SANDSPIT AIRPORT  
COMBINED SERVICES BUILDING (CSB)  
HVAC REHABILITATION

Consultant Signature Only

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PREETIPAL PAUL

Drawing title/Titre du dessin

SECOND FLOOR  
DEMOLITION PLAN AND  
SELECT SCHEDULES -  
HVAC

Project No./No. du projet

R.077014.001

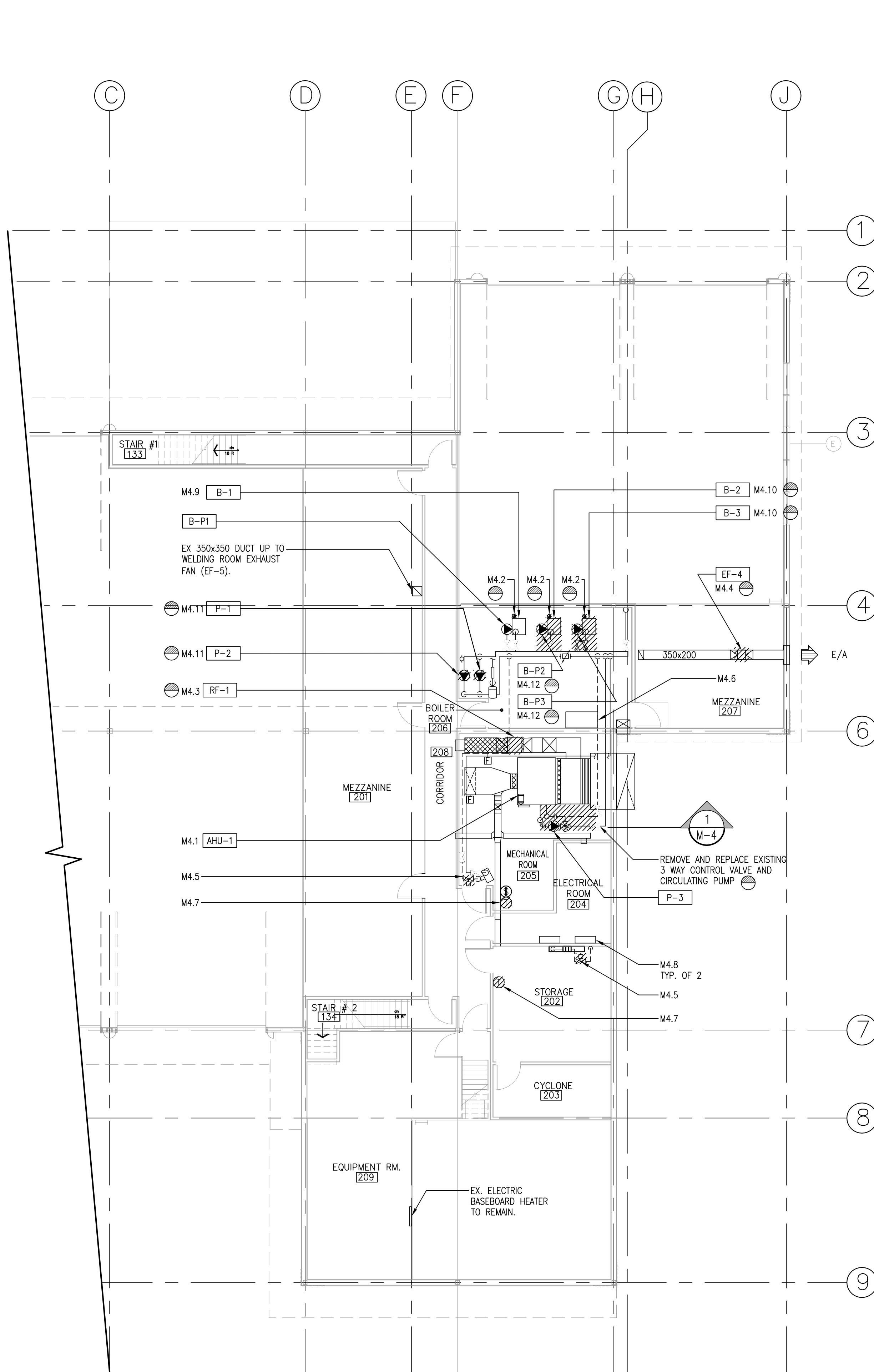
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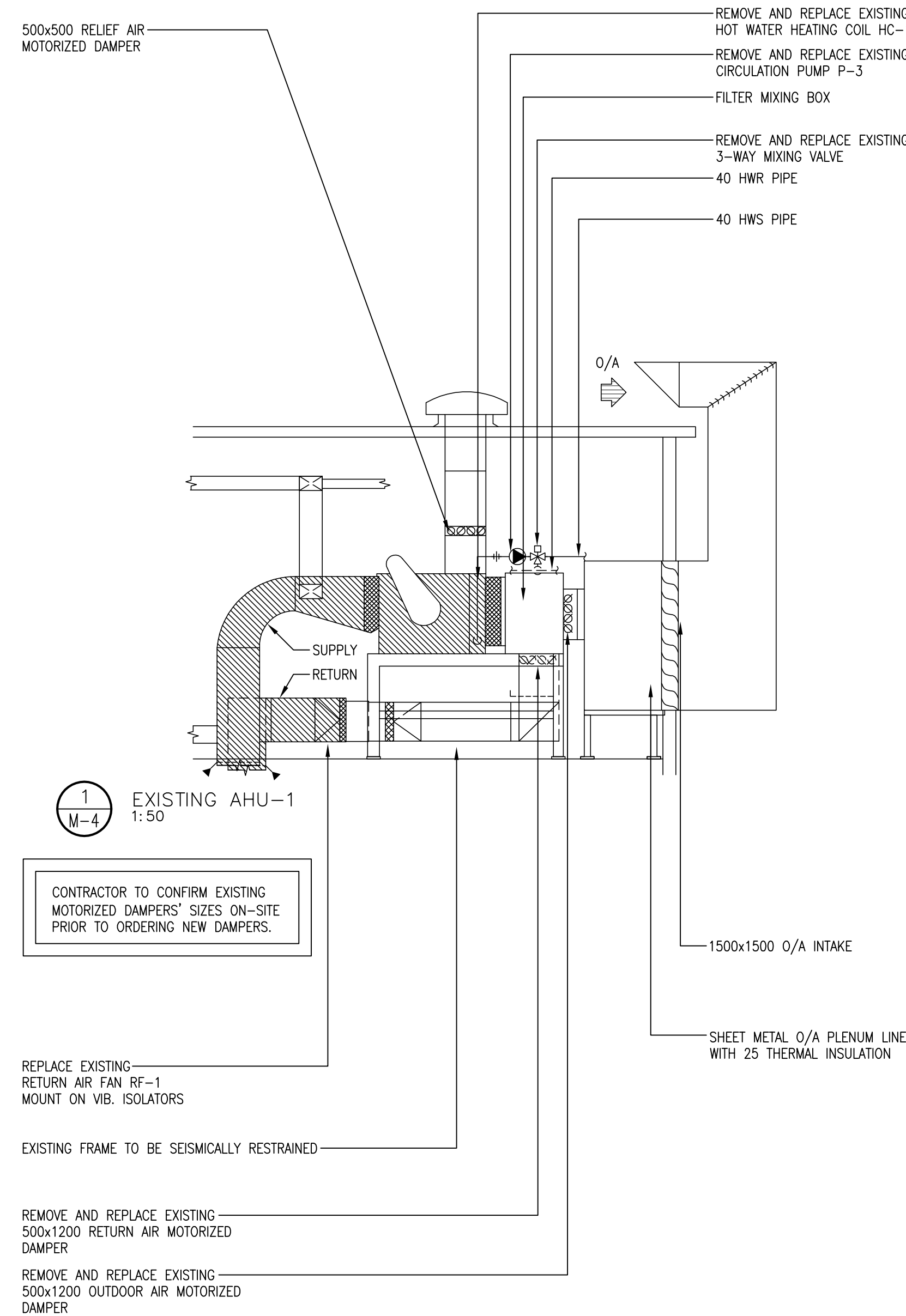
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no.

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SECOND FLOOR DEMOLITION PLAN - HVAC  
1:100



1  
M-4  
EXISTING AHU-1  
1:50  
CONTRACTOR TO CONFIRM EXISTING  
MOTORIZED DAMPERS' SIZES ON-SITE  
PRIOR TO ORDERING NEW DAMPERS.

REPLACE EXISTING  
RETURN AIR FAN RF-1  
MOUNT ON VIB. ISOLATORS

EXISTING FRAME TO BE SEISMICALLY RESTRAINED

REMOVE AND REPLACE EXISTING  
500x1200 RETURN AIR MOTORIZED  
DAMPER

REMOVE AND REPLACE EXISTING  
500x1200 OUTDOOR AIR MOTORIZED  
DAMPER



FIGURE 8: EXISTING AIR HANDLING UNIT TO BE REFURBISHED -  
MECHANICAL ROOM 205.

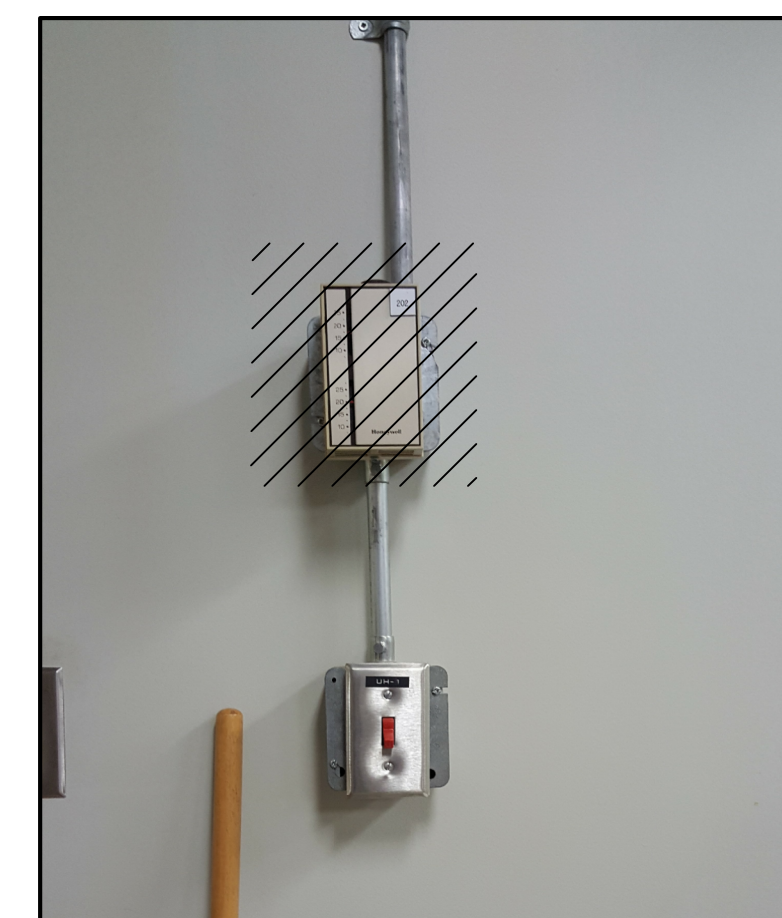


FIGURE 10: EXISTING UNIT HEATER THERMOSTAT TO BE  
REMOVED - MECHANICAL ROOM 205.

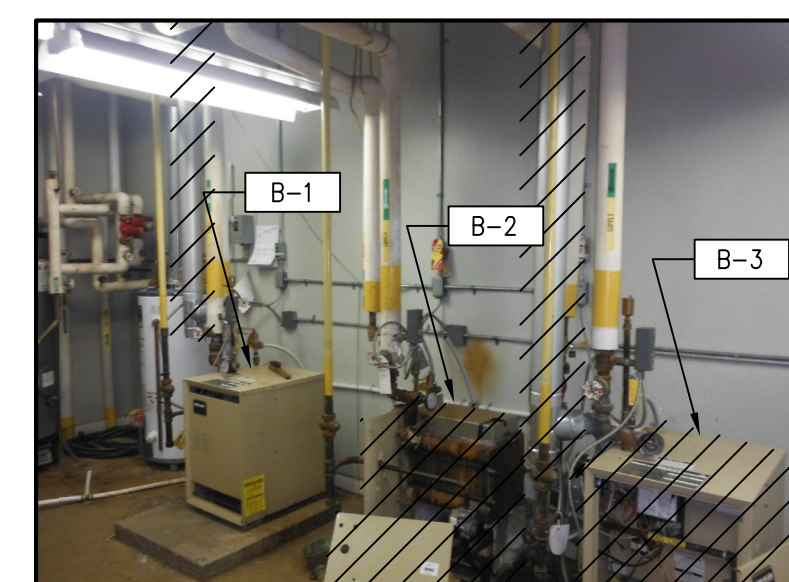


FIGURE 9: EXISTING BOILER DEMOLITION - MECHANICAL  
ROOM 205.



FIGURE 11: EXISTING COMPRESSOR TO BE SEISMICALLY  
RESTRAINED - MECHANICAL ROOM 205.

**DRAWING M-4 NOTES:**

- M4.1 REMOVE AND REPLACE EXISTING AIR HANDLING UNIT'S SUPPLY FAN MOTOR, BELTS, SHEAVES, HEATING COIL, DRIVES, OUTDOOR AIR DAMPERS AND RETURN AIR DAMPERS, AND THE THERMAL INSULATION ON THE O/A INTAKE PLENUM. SEISMICALLY RESTRAIN EXISTING AIR HANDLER REFER TO SPECIFICATIONS FOR REQUIREMENTS. REFER TO FIGURE 8 ON M-4.
- M4.2 REMOVE AND REPLACE EXISTING 100 mm BOILER VENT.
- M4.3 REMOVE AND REPLACE EXISTING TUBEXIAL RETURN FAN. RECONNECT TO EXISTING 550x550 RETURN DUCT. RE & RE EXISTING POWER SUPPLY AND CONTROLS.
- M4.4 REMOVE AND REPLACE EXISTING WASHROOM EXHAUST FAN. RE & RE EXISTING POWER SUPPLY AND CONTROLS.
- M4.5 REMOVE AND REPLACE EXISTING CONTROL VALVE.
- M4.6 SEISMICALLY RESTRAIN EXISTING COMPRESSOR UNIT. REFER TO SPECIFICATION FOR DETAILS. REFER TO FIGURE 11 ON M-4.
- M4.7 REMOVE AND REPLACE EXISTING THERMOSTAT. REFER TO FIGURE 10 ON M-4.
- M4.8 EXISTING DDC PANEL. REFER TO SPECIFICATION FOR DETAILS ON DDC UPGRADE.
- M4.9 EX. BOILER TO REMAIN. REFER TO FIGURE 9 ON M-4.
- M4.10 REMOVE AND REPLACE EX. BOILER. REFER TO FIGURE 9 ON M-4. REFER TO DRAWING M-5 (NOTE M5.11) FOR BOILER SCOPE.
- M4.11 REMOVE AND REPLACE EX. SECONDARY PUMP. REFER TO SPECIFICATION FOR DETAILS.
- M4.12 REMOVE AND REPLACE EXISTING PRIMARY PUMPS AND ASSOCIATED FITTINGS. REFER TO PARTIAL PIPING SCHEMATIC ON M-5.

**HEATING AND VENTILATING UNITS**

Mark	AHU-1 SF EX	AHU-1 RF EX
Service	CSB	CSB
Model	EA-LM-6-C	9624 Arr. 4
Fan Air Flow - L/s (cfm)	3304	7000
Fan External S.P. - Pa (in w.g.)	137.5	0.55
Fan Total S.P. - Pa (in w.g.)	400	1.6
Fan Size/Type	18/18 / FC DIDW	24" φ Impeller
Fan RPM	750	1750
Fan Horsepower	5	1.5
Filter Area - Square Meters (sq. Ft.)	1.4	15.0
Weight - kg (lbs.)	408	900
Notes	1	2

Interlock operation of supply fan with return fan as scheduled.  
Refer to Specification for accessories not scheduled. Refer to drawings for installation details.  
1. Existing Unit manufactured by Engineered Air. Replace existing fan motor, drives, heating coil, sheaves as specified and scheduled  
2. Unit is to be as manufactured by Sheldon or approved equal.

**HEATING COILS**

Mark	HC-1
Unit	AHU-1
Type	HOT WATER
Air Flow - L/s (cfm)	3165
Air P.D. - Pa (in w.g.)	138
Ent. Air Temp °C (°F)	4.0
Lvg. Air Temp °C (°F)	28.4
Ent. Water Temp °C (°F)	82.2
Lvg. Water Temp °C (°F)	50.6
Heating Cap. - kW (MBH)	93
Water Flow - L/s (gpm)	0.72
Water P.D. - kPa (ft.)	0.63
Notes	

Existing Unit manufactured by Engineered Air. Replace existing heating coil as specified and scheduled  
Refer to Specification for accessories not scheduled. Refer to drawings for installation details.



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**TRANSPORT CANADA**

Project title/Titre du projet  
**SANDSPIT, B.C.**  
TRANSPORT CANADA SANDSPIT AIRPORT COMBINED SERVICES BUILDING (CSB) HVAC REHABILITATION

Consultant Signature Only

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PREETIPAL PAUL

Drawing title/Titre du dessin  
**SECOND FLOOR NEW CONSTRUCTION PLAN, PARTIAL PIPING SCHEMATIC, AND SELECT SCHEDULES - HVAC**

Project No./No. du projet  
R.077014.001

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**M-5**

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**DRAWING M-5 NOTES:**

- M5.1 PROVIDE NEW BOILER VENTS WITH 125 DOUBLE WALL AL29-4C PER MANUFACTURER'S RECOMMENDATIONS. EX. BOILER TO REMAIN.
- M5.2 PROVIDE NEW EXPLOSION PROOF AND SPARK PROOF INLINE EXHAUST FAN TO BE MOUNTED IN MEZZANINE (201) IN ORDER TO SERVICE BATTERY ROOM (113).
- M5.3 PROVIDE NEW IN LINE EXHAUST FAN TO SERVICE WASHROOMS ON MAIN FLOOR. CONNECT TO EXISTING 350x200 DUCT. RE & RE EXISTING POWER SUPPLY AND CONTROLS.
- M5.4 REFURBISHED AHU. PROVIDE NEW FAN MOTOR, BELTS, SHEAVES, HEATING COIL, DRIVES, OUTDOOR AIR AND RETURN AIR DAMPERS. CLEAN INTERIOR OF EXISTING OUTDOOR AIR PLENUM AND REINSULATE WITH 25 mm THERMAL INSULATION. CONTRACTOR IS TO PROVIDE COMMISSIONING TO AHU SYSTEM AFTER UNIT IS FULLY REFURBISHED. REFER TO SPECIFICATION FOR DETAILS.
- M5.5 PROVIDE NEW CONTROL VALVE.
- M5.6 PROVIDE NEW RETURN FAN FOR AHU-1.
- M5.7 PROVIDE NEW INLINE EXHAUST FAN (EF-9) FOR CARPENTRY STORAGE ROOM (121). EXHAUST FAN IS SIZED TO PROVIDE 56 L/S GENERAL EXHAUST. CONNECT TO NEW 152 Ø DUCTWORK.
- M5.8 PROVIDE NEW PUMP. CONNECT TO EX. 50 HWR LINE. CONTROL CONTRACTOR IS TO PROVIDE ALL NECESSARY WIRING AND CONNECT TO MAGNETIC STARTERS PROVIDED BY DIVISION 26 FOR CONTROLS OF SECONDARY PUMPS [START/STOP/STATUS/ALARMS].
- M5.9 CONTRACTOR TO PROVIDE BOILER KILL SWITCH. REFER TO DIV. 26 DRAWINGS.
- M5.10 PROVIDE NEW CIRCULATOR PUMP. CONNECT TO NEW 32 HWR LINE. REFER TO SPECIFICATION FOR DETAILS. CONTROL CONTRACTOR IS TO PROVIDE ALL NECESSARY WIRING AND CONNECT TO MAGNETIC STARTERS PROVIDED BY DIVISION 26 FOR CONTROLS OF PRIMARY PUMPS [START/STOP/STATUS/ALARMS].
- M5.11 INSTALL NEW BOILER PER MANUFACTURER'S RECOMMENDATIONS. NEW BOILERS ARE PROVIDED BY TRANSPORT CANADA. NEW BOILERS SHALL BE WEIL-McLAIN CGI SERIES 3 GAS-FIRED WATER BOILERS. CONTRACTOR IS TO PROVIDE COMMISSIONING TO ALL BOILER UNITS.
- M5.12 REFER TO PARTIAL BOILER ROOM PIPING SCHEMATIC FOR PIPING DETAILS. BOILER ROOM FLOOR TO CEILING HEIGHT, AS TAKEN FROM RECORD DRAWINGS, IS 4.25 METRES.

EXHAUST FANS					
Mark	EF-4	EF-5	EF-9	EF-10	
Service	Men's WR Unisex WR	Welding RM	Carpentry Storage	Battery Room	
Model	VDK-10	WUBK-15	SQ-70-G	VDK-08	
Air Flow - L/s (cfm)	117 247	566 1200	54 114	57 120	
External S.P. - Pa (in w.g.)	125 0.5	325 1.3	56.5 0.2	125 0.5	
Horsepower	0.09	0.75	0.02	0.09	
Voltage/Phase (V/ph)	115 1	115 1	115 1	115 1	
RPM	1050	1250	1300	1400	
Sones	5	19.5	2.7	5.9	
Notes	4	1,2,5	2, 6	2,3	

Fans shall be as manufactured by Carnes or approved equal unless noted otherwise. Refer to specification for accessories not scheduled. Refer to drawings for installation details.

1. Complete with manual switch by Div. 16. Fan shall run intermittently.
2. Fan shall be complete with belt guard, special motor, explosion proof and spark proof motor enclosure.
3. Fan shall run continuously. Control contractor to provide fan status to DDC.
4. Fan to be interlocked with building occupied mode of operation by Control contractor. Provide fan status to DDC.
5. Spin and shod aluminum housing, integral drain opening, integral motor overload protection, electrical to provide starter and disconnect, adjustable motor sheave factory preset to requested rpm, ventilated motor compartment with motor out of airstream, non-overloading backwardly inclined wheel, isolated suspended motor wheel-drive assembly, spark resistant construction, polished CRS fan shaft with rust inhibitive coating, pillow block bearing L50 = 200,000 hrs, provide explosion proof motor.
6. Fan shall be manufactured by Greenheck or approved equal.

GRILLES, REGISTERS, DIFFUSERS	
Mark	EG-1
Service	Exhaust
Model	800/TB
Damper	
Finish	B12
Notes	

Grilles, Registers and Diffusers to be as manufactured by E.H. Price or approved equal.  
B12 finish denotes factory white baked enamel finish.

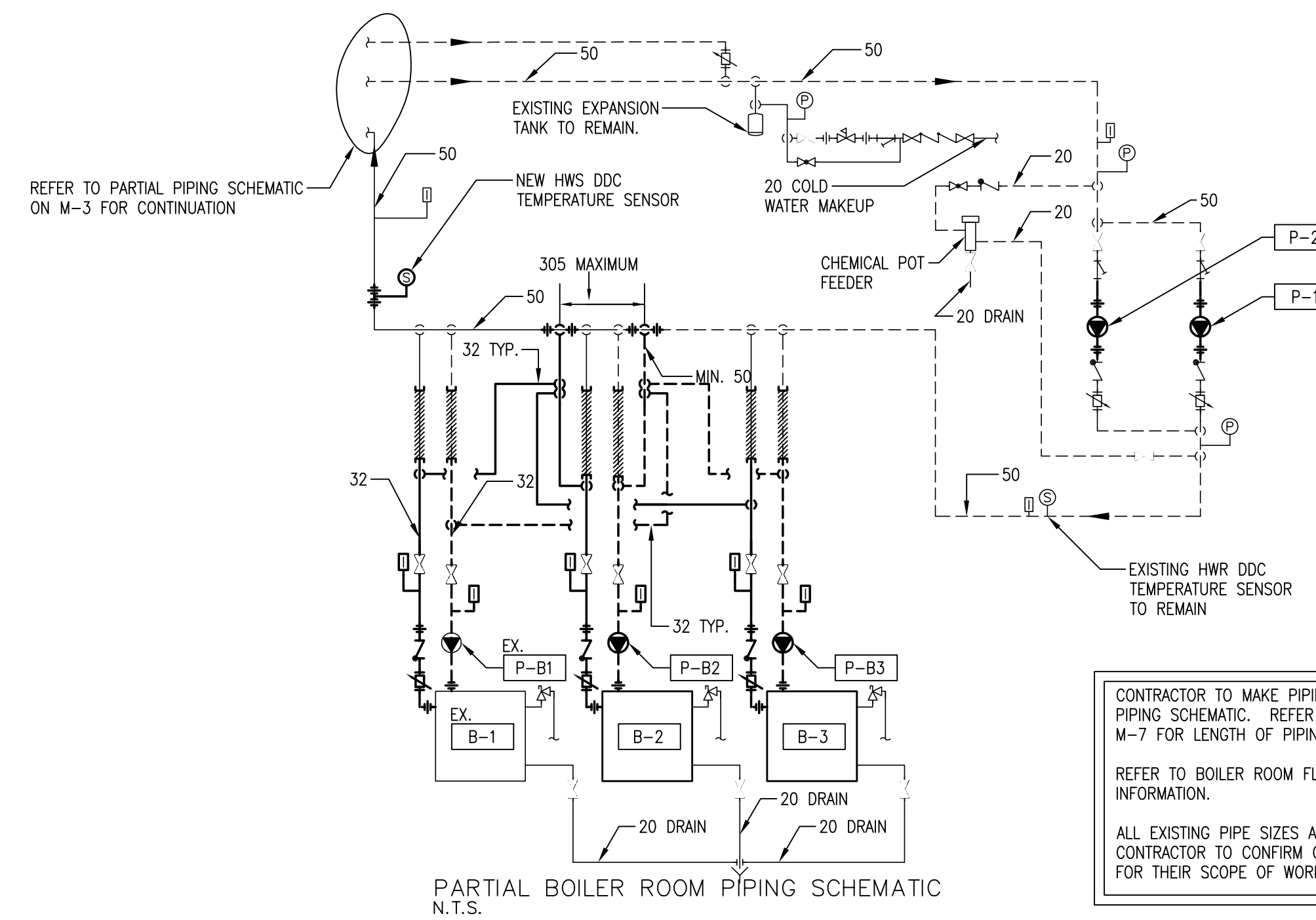
PUMPS					
Mark	P-1	P-2	P-3		
Model	1050 2B	1050 2B	HD3		
Location	Boiler Rm	Boiler Rm	MECHANICAL RM		
Service	Secondary pump	Secondary pump	AHU-1		
Flow - L/sec (usgpm)	1.58 25	1.58 25	0.76 12		
Head - kPa (ft.)	60 20	60 20	36 12		
Pipe Size - mm (in.)	51 2	51 2	38 1.5		
Horsepower	0.5	0.5	0.33		
Notes	2	2	1		

Pumps shall be installed with service clearances as required by pump manufacturer. Motors to be suitable for 120V/1ph/60 power and 1750 rpm unless noted otherwise.

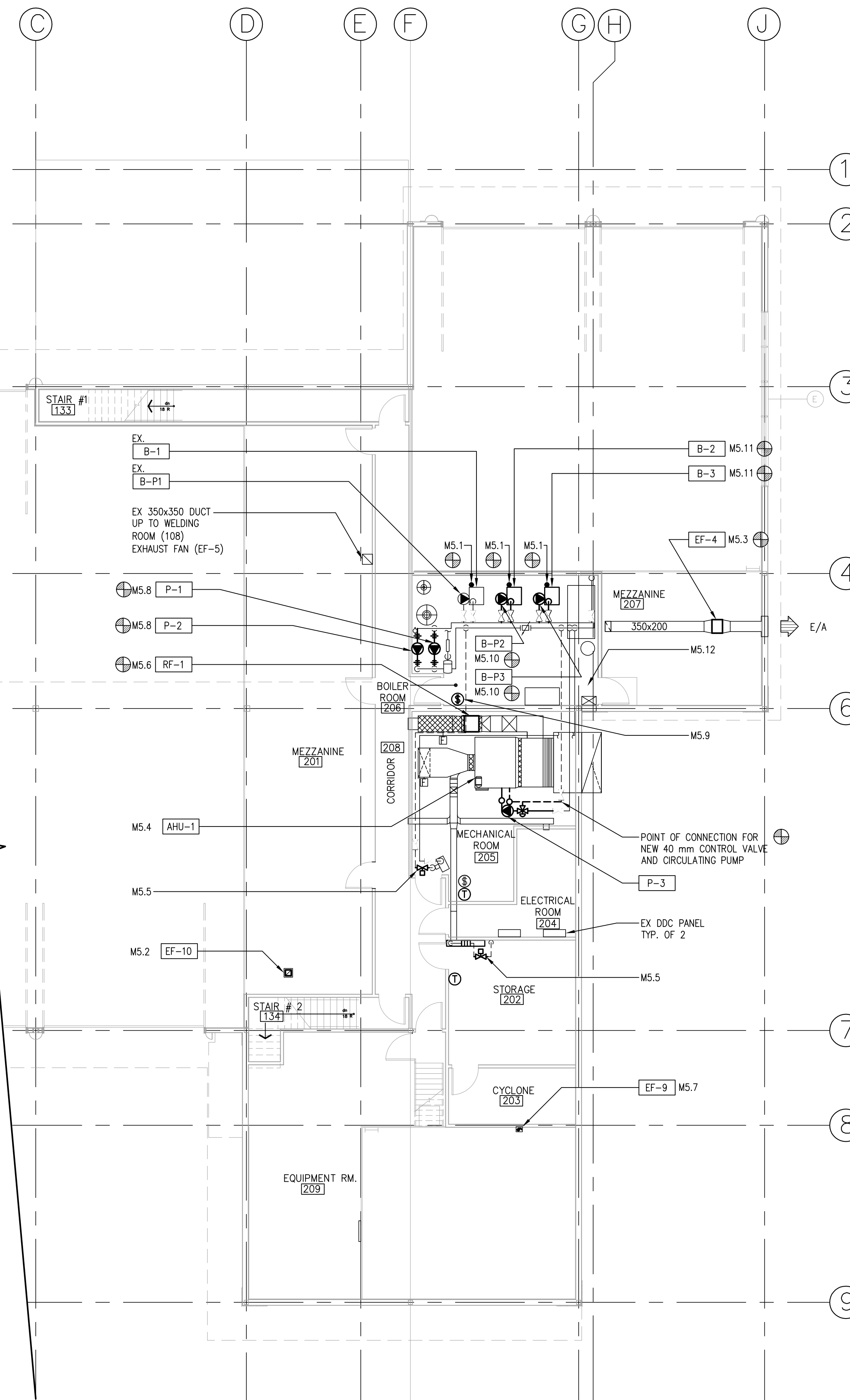
- Notes
1. Pump shall be manufactured by ITT B&G (1725 rpm, dual voltage 115V/1ph/60hz or 230V/1ph/60hz)
  2. Pump shall be manufactured by Armstrong (1800 RPM, dual voltage 120V/1ph/60hz or 208V/3ph/60hz)
  3. Pump shall be manufactured by Grundfos (RPM, 115V/1ph/60hz)

Boilers			
Mark	B-2	B-3	
Location	Boiler Rm (206)	Boiler Rm (206)	
Model	Weil-McLain CGI-6	Weil-McLain CGI-6	
Gas Input, High Fire - kW (MBH)	48.9 167.0	48.9 167.0	
Gas Output, High Fire - kW (MBH)	41.0 140.0	41.0 140.0	
Operating Weight - kg (lbs.)	164.5 362.0	164.5 362.0	
Notes			

Units shall be provided by the Departmental Representative. Units shall be available on site.  
Units tested at a working pressure of 345 kPa (50 PSI).  
Units fuelled by natural gas.



CONTRACTOR TO MAKE PIPING MODIFICATIONS AS INDICATED ON PIPING SCHEMATIC. REFER TO RECORD DRAWINGS ON DRAWING M-7 FOR LENGTH OF PIPING.  
REFER TO BOILER ROOM FLOOR PLAN FOR ADDITIONAL INFORMATION.  
ALL EXISTING PIPE SIZES ARE TAKEN FROM RECORD DRAWINGS. CONTRACTOR TO CONFIRM ON SITE ALL PIPE SIZES AS REQUIRED FOR THEIR SCOPE OF WORK.



SECOND FLOOR NEW CONSTRUCTION PLAN - HVAC  
1:100

SEAL:

Revision/ Révision	Description/Description	Date/Date
1	ISSUED FOR TENDER	07/27/2016

Client/client

TRANSPORT CANADA

Project title/Titre du projet

SANDSPIT, B.C.

TRANSPORT CANADA SANDSPIT AIRPORT  
COMBINED SERVICES BUILDING (CSB)  
HVAC REHABILITATION

Consultant Signature Only

Designed by/Concept par  
MLADEN MARKOVIC

Drawn by/Dessiné par  
SE

PWSSC Project Manager/Administrateur de Projets TPSSC  
JIMMY WONG

Regional Manager, Architectural and Engineering Services  
Gestionnaire régionale, Services d'architecture et de génie, TPSSC  
PREETIPAL PAUL

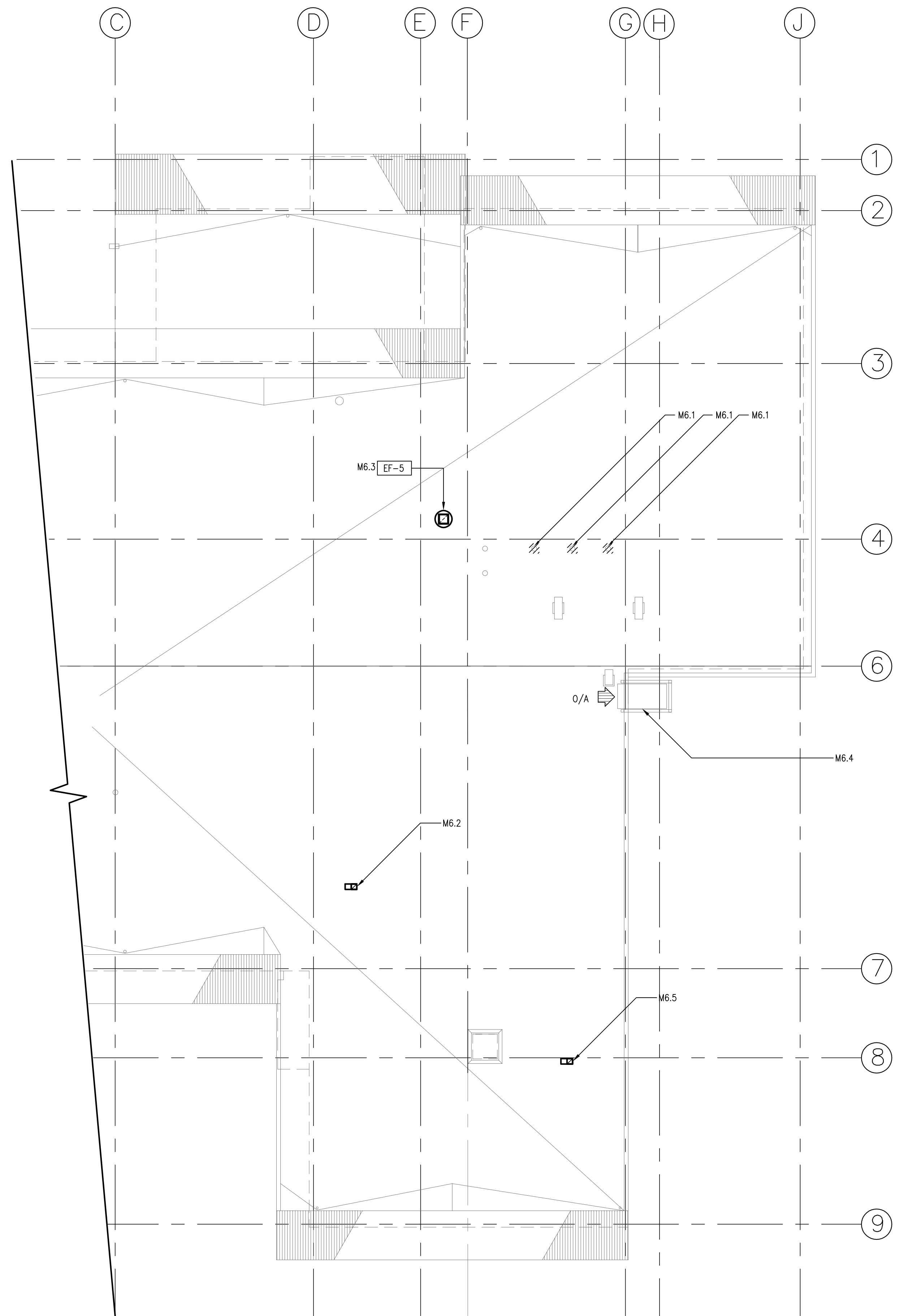
Drawing title/Titre du dessin

ROOF DEMOLITION PLAN,  
NEW CONSTRUCTION PLAN,  
AND DETAILS - HVAC

Project No./No. du projet  
R.077014.001

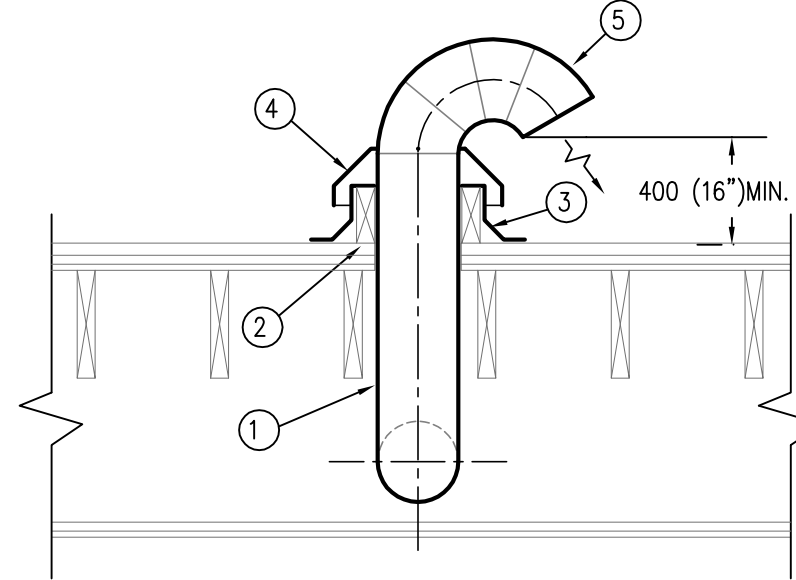
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M-6  
of 7

Revision no./  
La Révision  
no.  
1



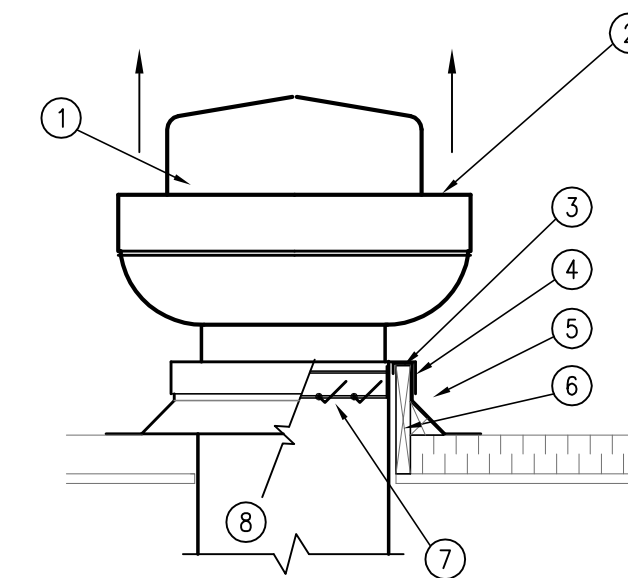
**DRAWING M-6 NOTES:**

- M6.1 REMOVE AND REPLACE VENT CONNECTED TO BOILER ON SECOND FLOOR. REPLACE WITH 125 STAINLESS STEEL DOUBLE WALL AL29-4C VENT. REFER TO FIGURE 12 ON M-6.
- M6.2 GOOSENECK DISCHARGE TO BE INSTALLED AND CONNECTED TO INLINE EXHAUST FAN (EF-10) SERVING BATTERY ROOM (113). REFER TO DETAIL.
- M6.3 REMOVE EXISTING ROOF MOUNT EXHAUST FAN (EF-5). PROVIDE NEW ROOF MOUNTED, SPARK RESISTANT, WELDING ROOM (108) EXHAUST FAN. REFER TO DETAIL.
- M6.4 REINSULATE EXISTING O/A INTAKE. REPAIR AS REQUIRED TO MATCH EXISTING FINISHES. REFER TO FIGURE 13 ON M-6.
- M6.5 GOOSENECK DISCHARGE TO BE INSTALLED AND CONNECTED TO INLINE EXHAUST FAN (EF-9) SERVING CARPENTRY STORAGE ROOM (121). REFER TO DETAIL.



- 1. DUCT. SIZE AS NOTED ON PLAN.
- 2. ARRANGE WITH GENERAL CONTRACTOR FOR OPENING THROUGH ROOF TO ACCOMMODATE DUCT.
- 3. ROOF CURB AND FLASHING AS PER RCABC REQUIREMENTS.
- 4. SQUARE TO ROUND CURB CAP.
- 5. WATER TIGHT DUCT ELBOW c/w 12mm(1/2") MESH ALUMINUM BIRDSCREEN ON DISCHARGE.

GOOSENECK  
N.T.S.



- 1. DISCONNECT SWITCH UNDER HOOD.
- 2. BIRD GUARD
- 3. CAULK ALL AROUND
- 4. GALVANIZED LAG SCREW TO BASE
- 5. FLASHING & COUNTER FLASHING
- 6. PROVIDE FAN MANUFACTURER'S CURB MINIMUM 200mm ABOVE FINISHED ROOF ELEVATION.
- 7. BACKDRAFT DAMPER
- 8. EXHAUST DUCT

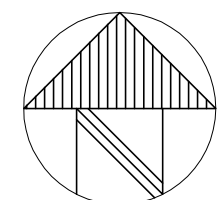
ROOF EXHAUST FAN (UPBLAST)  
N.T.S.



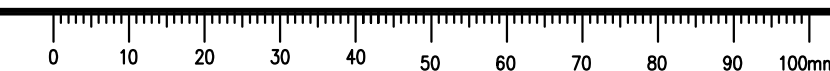
FIGURE 12: EXISTING BOILER VENTS TO BE DEMOLISHED -ROOF.



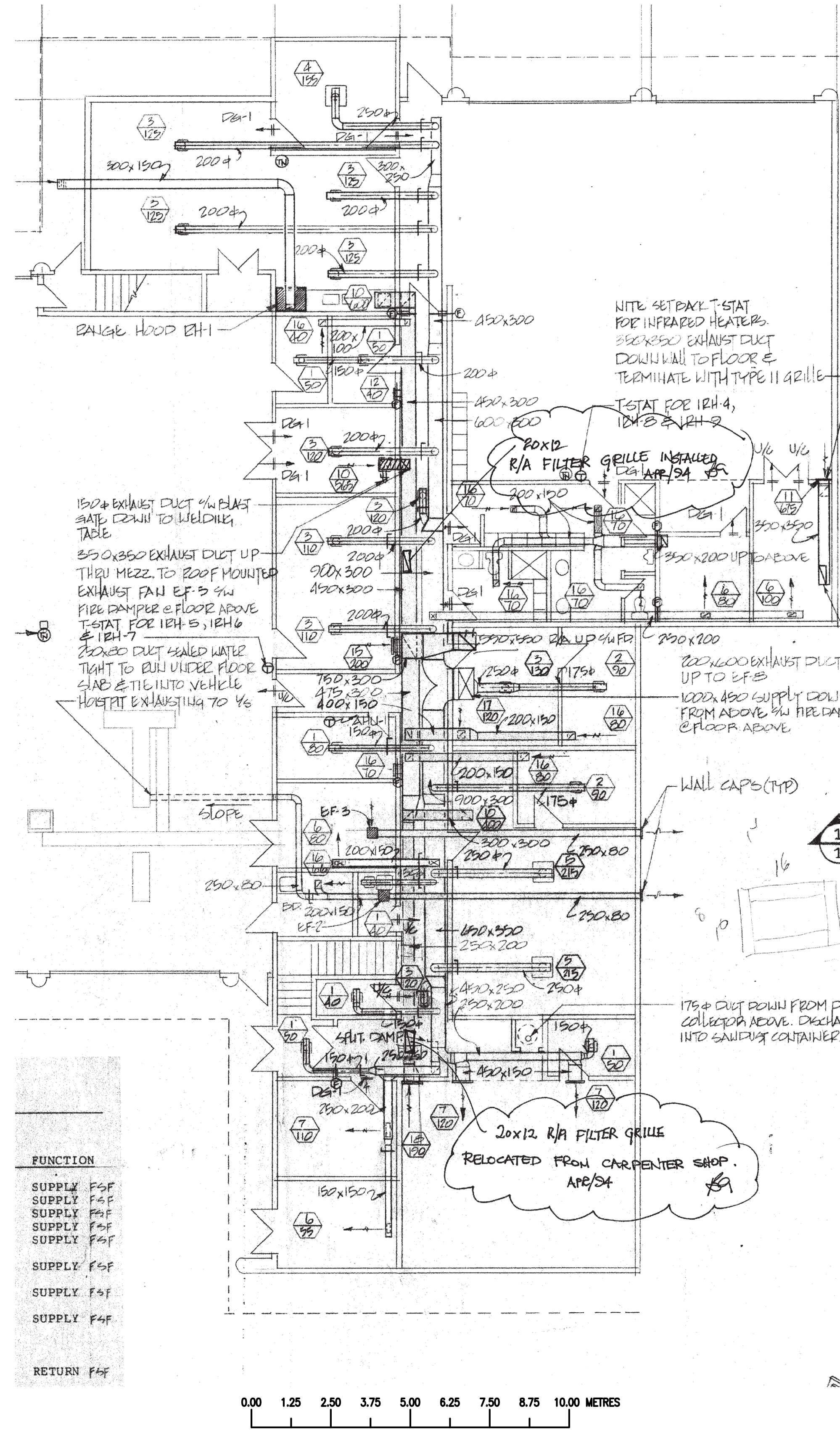
FIGURE 13: EXISTING O/A INTAKE. REINSULATE SECTION INSIDE OF BUILDING WITH 25 mm THERMAL INSULATION - EAST WALL.



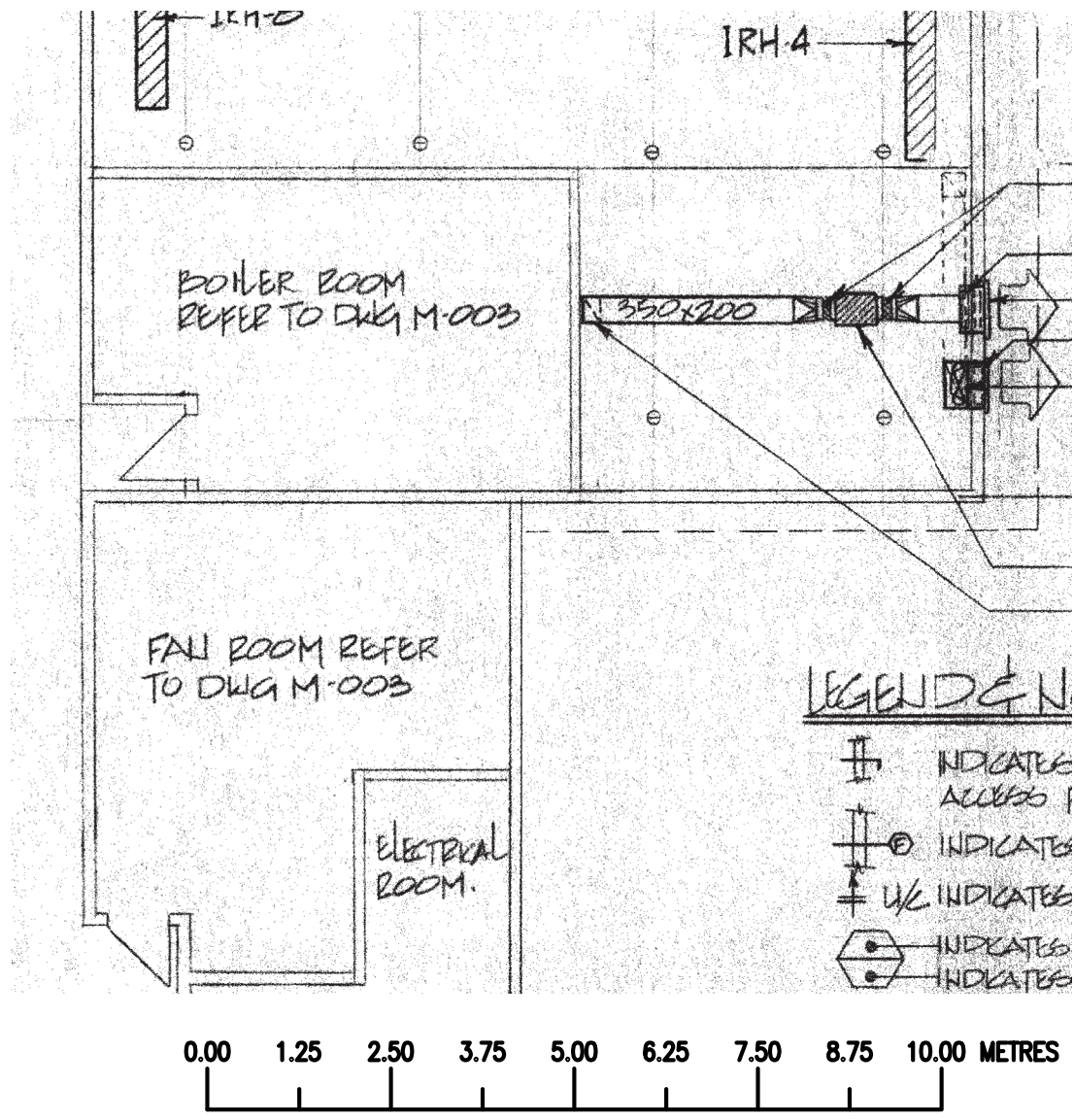
ROOF DEMOLITION PLAN AND NEW CONSTRUCTION PLAN- HVAC  
1:100



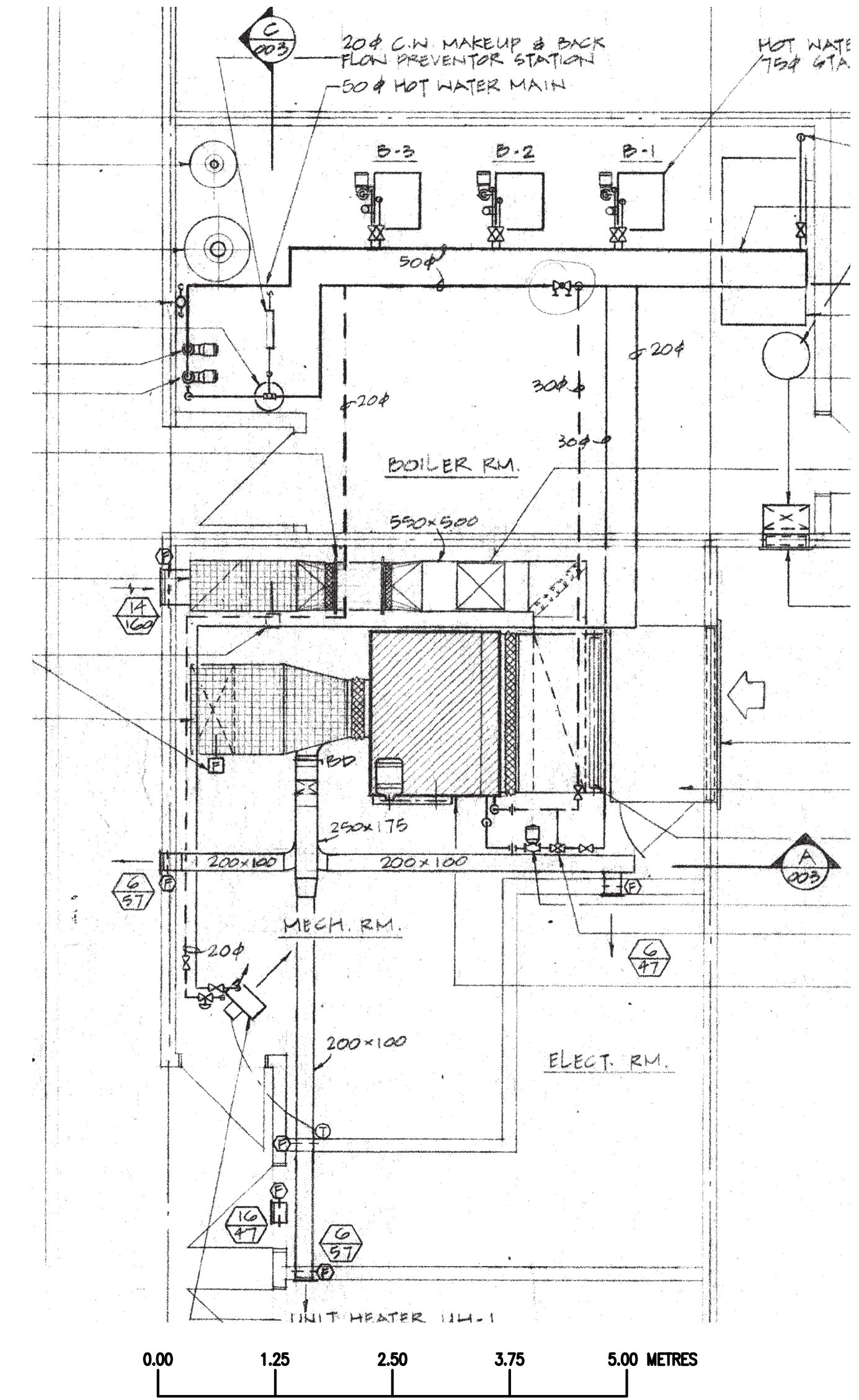




PARTIAL GROUND FLOOR PLAN - RECORD DRAWING 1:100



PARTIAL SECOND FLOOR PLAN - RECORD DRAWING 1:100



PARTIAL MECHANICAL AND BOILER ROOM PLAN - RECORD DRAWING 1:50

**DIFFUSERS, REGISTERS AND GRILLES**

REFERENCE NUMBER	DESCRIPTION	NEW SIZE	MODULE SIZE	MAX. AIR FLOW (L/S)	FUNCTION
1	SQ. CEILING DIFFUSER	150#	300 X 300	85	SUPPLY F&F
2	SQ. CEILING DIFFUSER	175#	300 X 300	105	SUPPLY F&F
3	SQ. CEILING DIFFUSER	200#	300 X 300	130	SUPPLY F&F
4	SQ. CEILING DIFFUSER	200#	600 X 600	170	SUPPLY F&F
5	SQ. CEILING DIFFUSER	250#	600 X 600	235	SUPPLY F&F
6	HORIZONTAL & VERTICAL BLADES ADJUSTABLE		200 X 100	100	SUPPLY F&F
7	HORIZONTAL & VERTICAL BLADES ADJUSTABLE		450 X 150	200	SUPPLY F&F
8	HORIZONTAL & VERTICAL BLADES ADJUSTABLE		500 X 350	600	SUPPLY F&F
9	HORIZONTAL & VERTICAL BLADES ADJUSTABLE				
10	12 X 12 X 12 ALUMINUM BGG CRATE	400 X 400		625	RETURN F&F
11	12 X 12 X 12 ALUMINUM BGG CRATE	350 X 600		875	EXHAUST F&F
12	FIXED HORIZONTAL BLADES @ 45° ALUM. C/W BALANCING DAMPER	300 X 150		95	RETURN
13	FIXED HORIZONTAL BLADES @ 45° ALUM. C/W BALANCING DAMPER	400 X 150		125	RETURN F&F
14	FIXED HORIZONTAL BLADES @ 45° ALUM. C/W BALANCING DAMPER	400 X 200		170	RETURN F&F
15	FIXED HORIZONTAL BLADES @ 45° ALUM. C/W BALANCING DAMPER	450 X 300		250	RETURN
16	FIXED HORIZONTAL BLADES @ 45° ALUM. C/W BALANCING DAMPER	200 X 200		95	EXHAUST F&F
17	FIXED HORIZONTAL BLADES @ 45° ALUM. C/W BALANCING DAMPER	250 X 250		140	RETURN F&F
18	FIXED HORIZONTAL BLADES @ 45° ALUM. C/W BALANCING DAMPER				
DG-1	AND 1" REPLACEABLE FILTER NO VISION ALUMINUM BLADE	500 X 300		190	RETURN F&F
		300 X 300		100	RETURN

F&F INDICATES DIFFUSERS/GRILLES/REGISTERS THAT REQUIRE FIRE STOP FLAPS

DIFFUSERS, REGISTERS, AND GRILLES - RECORD SCHEDULE NTS

RECORD DRAWINGS PROVIDED TO ALLOW FOR COST ESTIMATE OF DUCTWORK CLEANING AND CHEMICAL TREATMENT OF PIPING.  
 CONTRACTOR IS TO VERIFY EXISTING CONDITIONS ON SITE AND MAKE ALLOWANCE FOR MODIFICATIONS TO SUIT NEW SYSTEM INSTALLATION.

SEAL:

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Revision/	Description/Description	Date/Date

Client/client  
**TRANSPORT CANADA**

Project title/Titre du projet  
**SANDSPIT, B.C.**  
 TRANSPORT CANADA SANDSPIT AIRPORT COMBINED SERVICES BUILDING (CSB) HVAC REHABILITATION

Consultant Signature Only

Designed by/Concept par  
 MLADEN MARKOVIC

Drawn by/Dessine par  
 SE

PWSSC Project Manager/Administrateur de Projets TPSSC  
 JIMMY WONG

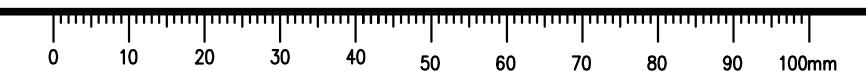
Regional Manager, Architectural and Engineering Services  
 Gestionnaire régionale, Services d'architecture et de génie, TPSSC  
 FREETIPAL PAUL

Drawing title/Titre du dessin  
**EXISTING SYSTEM DESCRIPTION - HVAC**

Project No./No. du projet  
 R.077014.001

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Revision/	Description/Description	Date/Date
Client/client		

TRANSPORT CANADA

Project title/Titre du projet  
**SANDSPIT, B.C.**  
TRANSPORT CANADA SANDSPIT AIRPORT  
COMBINED SERVICES BUILDING (CSB)  
HVAC REHABILITATION

Consultant Signature Only  
Designed by/Concept par  
L.P. GANDER  
Drawn by/Dessiné par  
LMG  
PWSC Project Manager/Administrateur de Projets TPSGC  
JIMMY WONG  
Regional Manager, Architectural and Engineering Services  
Gestionnaire régionale, Services d'architectural et de génie, TPSGC  
PRETRIPAL PAUL

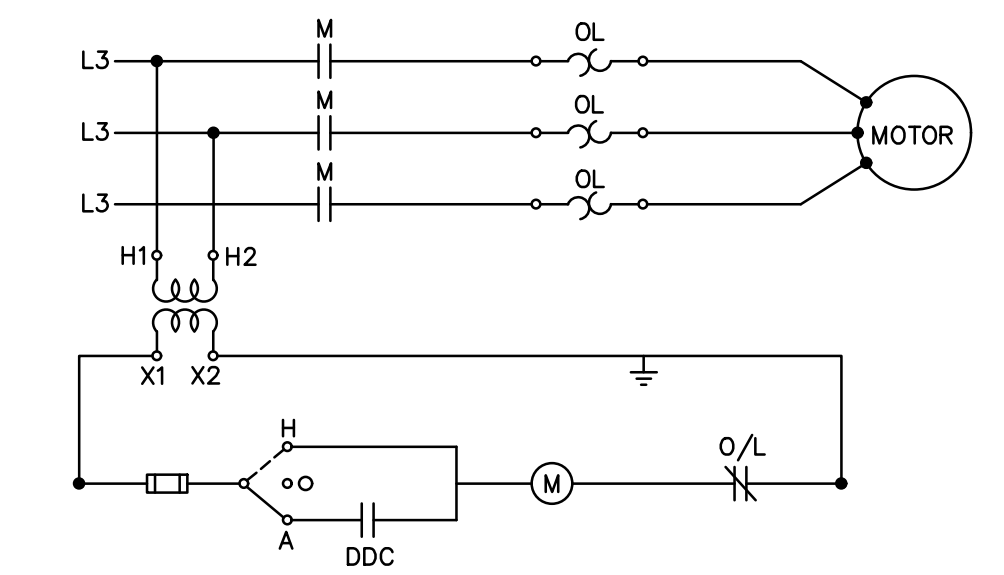
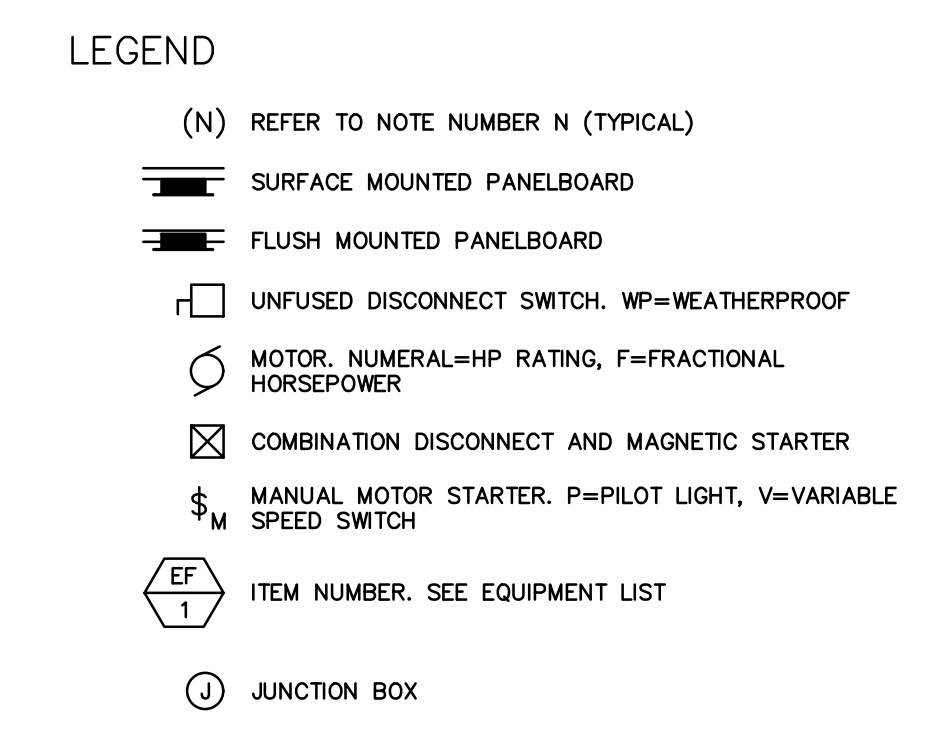
Drawing title/Titre du dessin  
**ELECTRICAL  
MAIN FLOOR PLAN**

Project No./No. du projet  
R.077014.001  
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**E-1**  
of 2  
Revision no./La Révision no.  
1

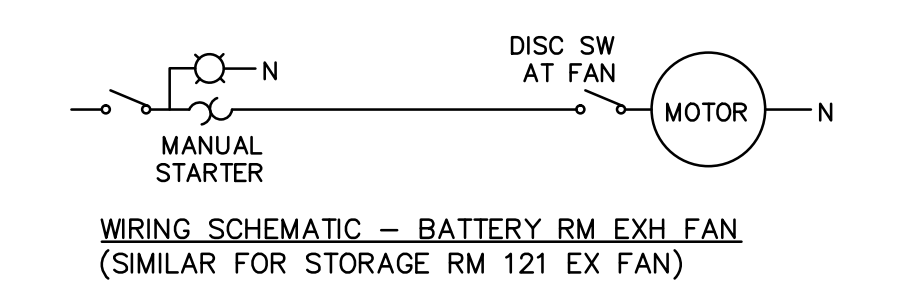
ITEM	DESCRIPTION	COMMENT	MECH DWG REFERENCE	ITEM REFERENCE
1	EXHAUST FAN FOR BATTERY ROOM. PROVIDE DISCONNECT FOR FAN AT FAN UNIT. FAN IS FRACTIONAL HORSE POWER AT 120V. FAN IS EXP PROOF	PROVIDE WIRING TO FAN FROM PANEL D. PROVIDE BREAKER IN SPARE SPACE IN EXISTING FPL. NBLP PANEL WIRING IN EMT WITH STEEL FITTINGS. FINAL CONNECTION TO FAN SHALL BE BY MEANS OF TECK CABLE WITH FITTINGS SUITABLE FOR CONNECTION TO CLASS 1 DIV 1 EQUIPT	M-5	EF-10
2	PROVIDE FLUSH MOUNTED MANUAL STARTER FOR BATTERY ROOM EXHAUST FAN. LOCATED FLUSH IN WALL OF ROOM ON OUTSIDE OF ROOM IN MAINTENANCE SHOP. LABEL STARTER	WIRE CONCEALED IN WALL IN TYPE AC (BX) CABLE. WIRING EXPOSED SHALL BE IN EMT. STARTER TO HAVE RUN PILOT LIGHT	-	-
3	REPLACE EXISTING WELDING EXHAUST FAN MANUAL STARTER	EXISTING STARTER IS SURFACE MOUNTED. REPLACEMENT UNIT TO BE SURFACE MOUNTED WITH RUN PILOT LIGHT	-	-
3A	DISCONNECT EXISTING 120V FRACTIONAL HP WELDING ROOM EXH FAN. RECONNECT TO NEW REPLACEMENT FAN. EXISTING FAN IS EXP PROOF AND REPLACEMENT FAN ALSO	REPLACE EXISTING BREAKER IN PANEL D WITH 25A 1P UNIT. RE-WIRE FROM BREAKER IN PANEL D TO PRECLUDE WIRING SPLICES. CONNECT TO FAN USING TECK CABLE WITH FITTINGS SUITABLE FOR CONNECTION TO CLASS 1 DIV 1 EQUIPT	M-6	M6.3 (EF-5)
4	REPLACE EXISTING BROKEN VAPOR TIGHT CEILING MOUNTED LIGHT FIXTURE IN BATTERY ROOM	REPLACE WITH VAPOR TIGHT LED TYPE UNIT BY KILLARK, RAB, APPLETON OR CROUSE-HINDS. SEE NOTE 1.	-	-
5	EXISTING RETURN AIR FAN. DISCONNECT EXISTING WIRING SO EXISTING UNIT CAN BE REFURBISHED. EXISTING FAN IS 1.5HP, 120V	FOLLOWING REFURBISHMENT RECONNECT TO FAN WITH FLEXIBLE CONNECTION AT FAN. REWIRE FROM STARTER TO FAN	M-4	RF-1
6	EXISTING AIR HANDLING UNIT FAN. DISCONNECT EXISTING WIRING SO EXISTING UNIT CAN BE REFURBISHED. EXISTING FAN IS NOMINAL 5HP 208V 3-PHASE	FOLLOWING REFURBISHMENT RECONNECT TO FAN WITH FLEXIBLE CONNECTION AT FAN. REWIRE FROM STARTER TO FAN	M-4	AHU-1
7	REPLACE EXISTING COMBINATION MAGNETIC STARTER WITH NEW. COMPLETE WITH H/O/A AND RUN PILOT LIGHT. COMBO STARTER IS FOR AHU-1	RE-WIRE FROM PANEL EC IN ELECTRICAL ROOM IN EXISTING CONDUIT AS NECESSARY TO PRECLUDE IN-LINE WIRING SPLICES. RECONNECT EXISTING CONTROLS INTO AUTO POSITION OF H/O/A IN STARTER	-	-
8	REPLACE EXISTING SEPARATE DISCONNECT SWITCH AND MAGNETIC STARTER WITH NEW COMBINATION MAGNETIC STARTER. COMPLETE WITH H/O/A AND RUN PILOT LIGHT. EXISTING STARTER IS FOR RETURN FAN RF-1	RE-WIRE FROM PANEL EC IN ELECTRICAL ROOM IN EXISTING CONDUIT AS NECESSARY TO PRECLUDE IN-LINE WIRING SPLICES. RECONNECT EXISTING CONTROLS INTO AUTO POSITION OF H/O/A IN STARTER	-	-
9	REPLACE EXISTING SEPARATE DISCONNECT SWITCH AND MAGNETIC STARTER WITH NEW COMBINATION MAGNETIC STARTER. COMPLETE WITH H/O/A AND RUN PILOT LIGHT. EXISTING STARTER IS FOR PUMP P-3 AND IS TO BE REPLACED TO RESET LIFE OF STARTER	RE-WIRE FROM PANEL EC IN ELECTRICAL ROOM IN EXISTING CONDUIT AS NECESSARY TO PRECLUDE IN-LINE WIRING SPLICES. RECONNECT EXISTING CONTROLS INTO AUTO POSITION OF H/O/A IN STARTER. IDENTIFY STARTER WITH LAMICOID LABEL	-	-
10	DISCONNECT WIRING TO EXISTING FRACTIONAL HP, 120V PUMP TO ALLOW REPLACEMENT. RECONNECT TO PUMP.	RECONNECT TO PUMP WITH SEALTITE FLEXIBLE CONNECTION. IDENTIFY STARTER WITH LAMICOID LABEL	M-4	P-3
11	DISCONNECT EXISTING 120V FRACTIONAL HP WASHROOM EXH FAN. RECONNECT TO NEW REPLACEMENT FAN	PROVIDE NEW LOCAL DISCONNECT SWITCH. RE-WIRE TO FAN FROM EXISTING BREAKER IN PANEL C IN ELECTRICAL ROOM AS NECESSARY TO PRECLUDE IN-LINE WIRING SPLICES	M-4	EF-4
11A	REPLACE EXISTING SEPARATE DISCONNECT SWITCH AND MAGNETIC STARTER WITH NEW COMBINATION MAGNETIC STARTER. COMPLETE WITH H/O/A AND RUN PILOT LIGHT. EXISTING STARTER IS FOR FAN EF-4	RE-WIRE FROM PANEL EC IN ELECTRICAL ROOM IN EXISTING CONDUIT AS NECESSARY TO PRECLUDE IN-LINE WIRING SPLICES. RECONNECT EXISTING CONTROLS INTO AUTO POSITION OF H/O/A IN STARTER	-	-
12	EXISTING BOILER B-2 AND ASSOCIATED BOILER FEED PUMP (8)	DISCONNECT EXISTING WIRING TO ALLOW BOILER AND FEED PUMP REPLACEMENT. RE-WIRE BOILER INSTALLATION TO BE ON EMERGENCY CIRCUIT. PROVIDE WIRING IN EMT FROM PANEL EC. PROVIDE BREAKER IN PANEL AS NECESSARY. REMOVE WIRING MADE OBSOLETE BY CONVERSION TO EMERGENCY POWER. REPLACE EXISTING LOCAL DISCONNECT SWITCH/MANUAL STARTER FOR BOILER WITH NEW	M-4	B-2
13	DISCONNECT WIRING TO EXISTING BOILER TO ALLOW BOILER AND FEED PUMP REPLACEMENT. FOLLOWING REPLACEMENT RE-CONNECT TO NEW BOILER	REPLACE EXISTING BOILER DISCONNECT SWITCH/MANUAL STARTER WITH NEW	M-4	B-3
14	DISCONNECT WIRING TO EXISTING FRACTIONAL HP 120V PUMPS P-1 AND P-2 TO ALLOW REPLACEMENT. RE-CONNECT FOLLOWING REPLACEMENT	REPLACE EXISTING MANUAL STARTERS ON WALL IN BOILER ROOM WITH NEW COMBO MAGNETIC STARTERS WITH H/O/A AND RUN PILOT LIGHTS	M-4	P-1 P-2
15	EXHAUST FAN FOR STORAGE ROOM 121. PROVIDE DISCONNECT AT FAN. FAN IS FRACTIONAL HORSEPOWER AT 120V	WIRE FROM EXISTING PANEL C IN ELECT ROOM. REMOVE 1 x 3P BREAKER TO MAKE ROOM. PROVIDE 3 x 15A 1P BREAKERS IN SPACE. USE 1 BREAKER TO WIRE TO FAN	M-5	EF-9
16	PROVIDE FLUSH MOUNTED MANUAL STARTER FOR STORAGE ROOM EXHAUST FAN. LOCATED FLUSH IN WALL OUTSIDE OF STORAGE ROOM 121 IN CARPENTRY 120	WIRE CONCEALED IN WALL IN TYPE AC (BX) CABLE. WIRING EXPOSED SHALL BE IN EMT	-	-

**NOTES**

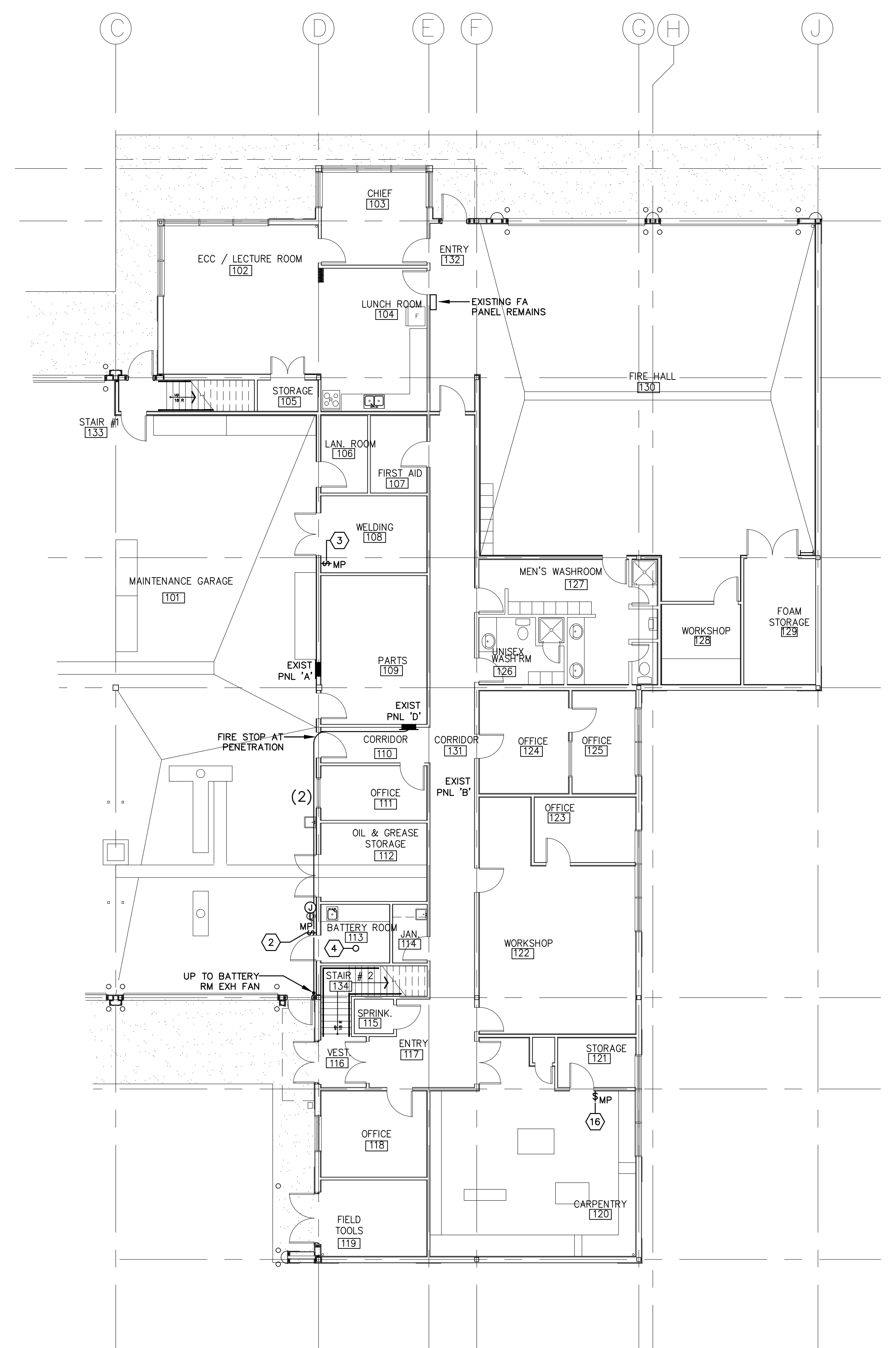
- LED LIGHT FIXTURE SHALL HAVE INPUT OF 26 WATTS PROVIDING 1700 LUMEN OUTPUT WITH CRI OF MINIMUM 82.
- CONCEAL WIRING FOR BATTERY ROOM EXHAUST FAN OUT OF PANEL D AND ABOVE CORRIDOR CEILING IN CORR 110. PENETRATE INTO GARAGE AND INSTALL EMT SURFACE MOUNTED AT HIGH LEVEL TO FAN. TERMINATE IN J-BOX ADJACENT TO FAN. CONNECT FAN USING TECK CABLE WITH FITTINGS SUITABLE FOR CONNECTION TO CLASS 1 DIV 1 HAZARDOUS LOCATION EQUIPMENT. (FAN IS IN LINE TYPE, EXPLOSION PROOF).
- PROVIDE THERMAL OVERLOADS IN ALL NEW STARTERS TO SUIT THE FANS OR MOTORS CONTROLLED.
- LAMICOID LABELS TO BE AFFIXED WITH CONSTRUCTION CEMENT. NO PREGUMMED LABELS.
- LEAVE ALL ELECTRICAL REPLACEMENTS, DISCONNECTS AND RECONNECTIONS IN COMPLETE OPERATING CONDITION PER EXISTING INSTALLATION.
- UPDATE PANEL SCHEDULES FOR PANELS IN WHICH CIRCUITS ARE ADDED. RE-TYPE PANEL SCHEDULE WITH UPDATED INFORMATION.
- ALL PANELBOARDS NOTED IN THESE DOCUMENTS ARE FPE, NBLP TYPE EXCEPT PANEL EC, WHICH IS CUTLER HAMMER PL-1.
- PROVIDE 15A 1P BREAKER IN SPARE SPACE IN PANEL EC FOR BOILER B-2.



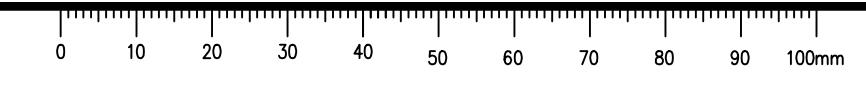
AHU-1 TYPICAL MOTOR CONTROL WIRING SCHEMATIC. 3-PHASE (SIMILAR FOR 1-PHASE MOTORS P-1, P-2)



WIRING SCHEMATIC - BATTERY RM EXH FAN (SIMILAR FOR STORAGE RM 121 EX FAN)



MAIN FLOOR PLAN - ELECTRICAL  
Scale: 1:100





J M BEAN & CO. LTD

Consulting Mechanical Engineers

PROJECT NUMBER: 1525.00

L.P. GANDER &  
ASSOCIATES LTD.  
CONSULTING ENGINEERS ELECTRICAL

SEAL:

1	ISSUED FOR TENDER	07/27/2016
Revision/	Description/Description	Date/Date

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TRANSPORT CANADA

Project title/Titre du projet

SANDSPIT, B.C.

TRANSPORT CANADA SANDSPIT AIRPORT  
COMBINED SERVICES BUILDING (CSB)  
HVAC REHABILITATION

Consultant Signature Only

Designed by/Concept par  
L.P. GANDER

Drawn by/Dessiné par  
LMG

PWSC Project Manager/Administrateur de Projets TPSC  
JIMMY WONG

Regional Manager, Architectural and Engineering Services  
Gestionnaire régionale, Services d'architectural et de génie, TPSC  
PREETIPAL PAUL

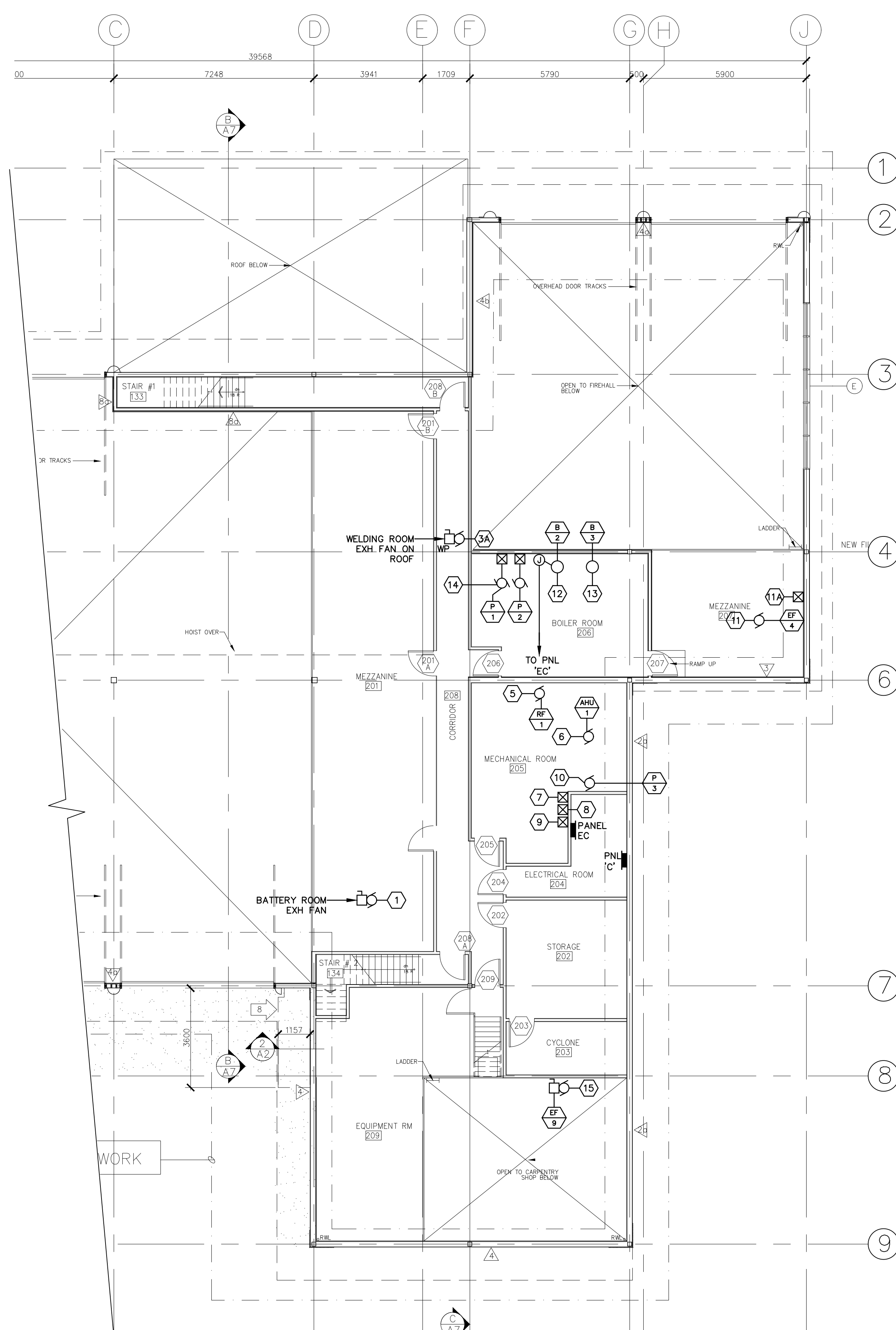
Drawing title/Titre du dessin

ELECTRICAL  
SECOND FLOOR PLAN

Project No./No. du  
projet  
R.077014.001

Sheet/Feuille  
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1



SECOND FLOOR PLAN - ELECTRICAL  
Scale: 1:100

MECHANICAL EQUIPMENT SCHEDULE:

UNIT NUMBER	DESCRIPTION	LOCATION	LOAD			VOLT/PHASE	FEEDER	STARTER			LOCATION	DISC. AT MOTOR	OPERATION	NOTES	
			HP	KW	MCA			TYPE	SUPPLY	MOUNT					CONNECT
AHU-1	AIR HANDLING UNIT	UPPER MECH RM	5			208/3	3#10AWG	MC-2,3,4,5	X	X	X	UPPER MECH RM	-	AUTOMATIC	A
P-1	HW CIRC PUMP	BLR RM	0.5			120/1	2#12AWG	MC-2,4,5	X	X	X	BLR RM	-	AUTOMATIC	B
P-2	HW CIRC PUMP	BLR RM	0.5			120/1	2#12AWG	MC-2,4,5	X	X	X	BLR RM	-	AUTOMATIC	B
P-3	HW CIRC PUMP	UPPER MECH RM	FRAC			120/1	2#12AWG	MC-2,4,5	X	X	X	UPPER MECH RM	-	AUTOMATIC	A
RF-1	RETURN FAN	UPPER MECH RM	1.5			120/1	2#10AWG	MC-2,4,5	X	X	X	UPPER MECH RM	-	AUTOMATIC	A
EF-4	WC EXH FAN	MEZZANINE	FRAC			120/1	2#12AWG	MC-2,4,5	X	X	X	MEZZANINE	S	AUTOMATIC	A
EF-5	EXH FAN	ROOF	0.75			120/1	2#12AWG	MN-4	X	X	X	WELDING ROOM	S	MANUAL	C, D
EF-9	EXH FAN	UPPER CARPENTRY	FRAC			120/1	2#12AWG	MN-4	X	X	X	CARPENTRY	S	MANUAL	
EF-10	EXH FAN BATTERY ROOM	MEZZANINE	FRAC			120/1	2#12AWG	MN-4	X	X	X	GARAGE	S	MANUAL	C

MG = MAGNETIC      MN = MANUAL      MC = MAGNETIC COMBINATION      X = INCLUDED UNDER DIV 26      S = SUPPLY  
 1 = STOP/START PUSHBUTTON      2 = HAND-OFF-AUTO SELECTOR SWITCH      3 = FUSED CONTROL CIRCUIT TRANSFORMER      4 = PILOT LIGHT      T = SUPPLIED BY OTHERS  
 5 = EXTRA AUXILIARY CONTACTS, 2 NO, 2 NC, INTERCHANGEABLE

NOTES

- A. RETAIN EXISTING CONTROLS CONNECTION.
- B. DDC WIRING BY MECH CONTRACTOR.
- C. FAN IS EXP. PROOF. CONNECT WITH CLASS 1 DIV 1 WIRING.
- D. REPLACE EXISTING BREAKER IN PANEL TO SUIT NEW EXH FAN SIZE.

